Onan

Service Manual

OT

Transfer Switches

Prior to Spec E

962-0503
6-83
Printed in U.S.A.

Safety Precautions

This manual includes the following symbols to indicate potentially dangerous conditions to the operator or equipment. Read the manual carefully and know when these conditions exist. Then take the necessary steps to protect personnel and the equipment.

WARNING ***This symbol is used throughout the text to warn of possible serious personal injury or death.***

CAUTION ***This symbol refers to possible equipment damage.***

The automatic transfer switch has components with high voltages which present shock hazards which might cause serious personal injury or death. For this reason, read the following suggestions.

Keep the automatic transfer switch cabinet closed and locked. Make sure only authorized personnel have the cabinet keys.

Always move the operation selector switch on the generator set or automatic transfer switch to *STOP*, disconnect the starting batteries of the generator set, and remove AC line power to the automatic transfer switch before performing maintenance or adjustments (unless specified otherwise in the instructions—then only using extreme caution due to danger of shock hazard).

Before using the disconnect plug (if equipped) for de-energizing the control panel, be sure to place the operation selector switch on the generator set or automatic transfer switch to the *STOP* position. Neglect of this procedure results in set starting and energization of the transfer switch generator side.

Use rubber insulative mats placed on dry wood platforms over floors that are metal or concrete when working on any electrical equipment. Do not wear damp clothing (particularly wet shoes) or allow skin surfaces to be damp when handling electrical equipment.

Jewelry is a good conductor of electricity and should be removed when working on the electrical equipment.

Do not work on this equipment when mentally or physically fatigued.

Table of Contents

General Information

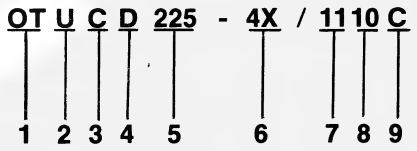
ONAN SERVICE MANUAL

This manual contains operation descriptions of typical OT transfer switches, modifications, adjustments, and troubleshooting procedures. Whenever troubleshooting or planning a repair for an OT automatic transfer switch, remember the generator set, automatic transfer switch and commercial power source are all interdependent. Decide which is the source of the problem and then repair using necessary and normal safety precautions.

The service manual contains operation descriptions of typical OT automatic transfer switches, and modifications, adjustments, and toubleshooting procedures. Non-automatic OT transfer switches do not have a control system as do the automatic transfer switches. Because of this, use only the *Transfer Switch* section for service information on these models.

MODEL NUMBER SYSTEM

Following is a typical model number with explanations of the different parts.



1. **Series Identification**
2. **Transfer Switch Type**
   - U-2-or 3-pole transfer switch
   - N-2-or 3-pole transfer switch with over-lap switched neutral
   - S—Special or CSA Approved
3. **Starting Circuit**
   - C—2-wire, 24-volt
   - D—2-wire, 12-volt
   - E—3-wire, 12-volt
   - A—Non-automatic
   - B—No Starting circuit, utility-to-utility model.
4. **Transfer Switch and Cabinet Combinations**

   All transfer switches below are mechanically-held both sides and have manual operators.
   - D—two auxiliary contacts on each side, NEMA 1 cabinet
   - H—Two auxiliary contacts on each side, open construction model
   - K—One auxiliary contact on each side, programmed transition, NEMA 1 cabinet
   - L—One auxiliary contact on each side, programmed transition, open construction
   - M—Two auxiliary contacts on each side, NEMA 1 cabinet, dust-proofed
   - N—One auxiliary contact on each side, programmed transition, NEMA 1 cabinet, dust-proofed
   - P—One auxiliary contact on each side, programmed transition, rainproof cabinet
   - R—Programmed transition, NEMA 1 cabinet
   - S—Programmed transition, open construction
5. **Current Rating (amperes)**
6. **Voltage Code**
   - 3 —120/240, 1-phase, 3-wire
   - 4 —120/208, 3-phase, 4-wire
   - 4X—277/480, 3-phase, 4-wire
   - 5D—120/240, 3-phase, 4-wire delta
   - 7 —220/380, 3-phase, 4-wire
   - 9X—347/600, 3-phase, 4-wire

Voltage code with prefix "5" indicates 50 hertz (e.g. 53 indicates 50 hertz, 120/240 volts, 1-phase, 3-wire).

7. CONTROL ACCESSORY GROUP

7A. SOLID-STATE, MODULAR CONTROL PANELS
(GROUPS 10-17, 20-25, AND 99)

ACCESSORY	GROUP								
	10 20	11 21	12 22	13 23	14 24	15 25	16	17	99*
Normal-Test Switch	X	X	X	X	X	X	X	X	
With Load-Without Load Selector Switch	X	X	X	X	X	X			
Start-Stop Time Delay	P	X	X	X	X	P		X**	
Transfer-Retransfer Time Delay	P	P	X	X	X	X	X	X	
Cranking Limiter (OT-E only)	X	X	X	X	X	X		X**	
Preheat Time Delay (OT-E only)	W	W	W	W	W	P		W**	
Undervoltage Sensor (1 per phase on normal side)	X	X	X	X	X	X	X		
Undervoltage Sensor (1 for normal side)								X	
Undervoltage Sensor (1 for emergency side)	X	X	X	X	X	X	X	X	
Overvoltage Sensor (1 per phase)	W	W	W	W	X	P			
Overvoltage Sensor (1 per side)								W	
Frequency Sensor (1 per side)								W	
Battery Charger Module		X	X	X	X	P			
Battery Voltage Sensor Module	W	W	W	W	X	P			
Exerciser Clock		W	X	X	X	W			
Time Switch (168-hour)								X	
No Control Panel (non-automatic models*)									X

* Non-automatic does not have control accessory panel.
** One per generator set.

X = Supplied standard.
P = Plug-in module package available.
W = Wire-in package available.

7B. RELAY TYPE CONTROL PANELS
(GROUPS 51-55)

ACCESSORY	GROUP				
	51	52	53	54	55
Normal-Test Switch	X	X	X	X	X
Start Time Delay	W	W	W	X	X
Transfer Time Delay	W	W	W	W	X
Retransfer Time Delay	W	X	X	X	X
Stop Time Delay	W	W	W	W	X
Cranking Limiter (OT-E only)	X	X	X	X	X
Exerciser Clock	W	W	X	X	X
Preheat Time Delay (OT-E only)	W	W	W	W	W
Undervoltage Sensor (line)	W	W	W	W	W
Undervoltage Sensor (gen)	W	W	W	W	W
Overvoltage Sensor (line)	W	W	W	W	W
Overvoltage Sensor (gen)	W	W	W	W	W
Battery Charger - 2 Amp SCR Float	W	W	W	W	W
Battery Charger - 50 to 300 ma Trickle	W	W	W	W	W

X = Supplied standard.
W = Wire-in package available.

8. Meter-Lamp Combination:

Accessory	Group																				
	01	02	03	04	05	06	07	08	09	10	11	12	13	14	15	16	17	18	19	20	21
Charge Ammeter	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X					
Overcrank Lamp (OT-E only)	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X	X			
Normal-Emergency Lamps	W	X	W	X	W	X	W	X	W	X	W	X		X		X		X	X		X
Battery Voltage Lamps			X	X			X	X			X	X			X	X					
AC Voltmeter					X	X	X	X	X	X	X	X									
Frequency Meter									X	X	X	X									
Running Time Meter									X	X	X	X	X	X	X	X					
Emergency-Remote-Normal Selector Switch																					X
Gen #1 Overcrank, Gen #2 Overcrank Lamps																				X	
Gen #1 Running, Gen #2 Running Lamps																				X	
Gen #1 Overloaded, Gen #2 Overloaded Lamps																				X	

X = Supplied standard.
W = Wire-in package available.

9. Specification Letter: Advances with production modification.

Operation Description

The detailed operation description following is intended only as an aid in understanding and servicing the automatic transfer switch. For example, if after using the OT troubleshooting in the back part of the service manual, you can follow a particular part of the operation description to understand why or how such a problem occurred.

The service manual gives two operation descriptions, one for an OT with a solid-state, modular type control accessory panel (control panel groups 10 through 15 and 20 through 25) and one for an OT with a relay-type control accessory panel (control panel groups 51 through 55). The descriptions apply to typical models and might not directly relate to the model you are servicing.

Wiring diagams referenced in the operation description appear at the end of this section. Note each one has three parts: a pictorial wiring diagram, a schematic, and a parts list.

Most model OT automatic transfer switches use three schematic wiring diagrams. One diagram covers the meter-lamp panel portion, one covers the control accessory panel portion, and one covers the transfer switch-cabinet portion. If you wish to follow the schematic wiring diagram as you read the operation description, you will have to use and follow all three schematic wiring diagrams referenced in the text.

OTs WITH CONTROL ACCESSORY GROUPS 10-15 AND 20-25

NORMAL OPERATION

Under normal conditions, the normal commercial line supplies power to the load from normal lines A, B, and C, and through the normal-side contacts shown in schematic 626-0375. Linear motor M1 is originally energized from normal line A, closed K1 contacts (7-8), TB31-2, disconnect switch S1, CB1, motor M1 windings, normally-open limit switch S2 contacts, TB31-1, K1 contacts (3-4), to normal line B. Once the transfer switch is picked up by the normal line side, it is mechanically held in that position and limit switch S2 normally-closed, held-open contacts disconnect power from motor M1.

In the normal position, S2 switch contacts are closed to light the normal lamp DS11 through a circuit completed from normal line B, contacts K1 (3-4), TB31-1, S2 switch contacts, TB31-5, TB7-10 (drawing 626-0364), through transformer T11 primary windings, TB7-11 (drawing 626-0375), to normal line A. The primary of T11 (drawing 626-0364) induces a voltage in the secondary windings to light "NORMAL" lamp DS11 on the meter-lamp panel.

BATTERY CHARGING

Transfer switch normal lines A and B feed receptacle terminals X and Y (drawing 626-0375) and disconnect plug P1 terminals X and Y (drawing 626-0445) to energize battery charger transformer T1 through fuse F1. Transformer T1 has three secondary terminals, X1, X2 and X3. Terminals X1 and X2 supply approximately 20 volts output for 12-volt battery charging. Terminals X1 and X3 supply approximately 40 volts output for 24-volt battery charging.

For 12-volt battery charging, transformer terminal T1-X2 connects to resistor R1-2, and transformer T1-X1 connects to terminal 15 of battery charger plug-in module 6. Resistor terminal R1-1 connects to terminal 21 of battery charger module 6 to complete the battery charger input circuit. The battery charger rectifies the AC power to produce DC power and regulates it to float-charge the battery.

Positive output terminal 2 on module 6 supplies charging current through TB6-2 (drawing 626-0375), TB7-2 (drawing 626-0364) through the ammeter M11, TB7-1 (drawing 626-0375), TB6-1 (drawing 626-0445) to the B+ terminal on TB1 which connects to the positive terminal of the battery. Terminal 4 of plug-in module 6 connects to the ground terminal which in turn connects to the negative terminal of the battery. This battery charging module 6 has a rated output of 2 amperes maximum and is voltage regulated to float-charge the battery continuously without battery damage.

POWER OUTAGE

When a power outage occurs (commercial power source), primary voltage to transformers T2, T4 and T5, supplied from lines A, B and C through terminals X, Y, and Z of the disconnect plug (drawing 626-0375), disappears. Secondary transformer voltages also go to zero (drawing 626-0445). With zero input voltage to voltage sensor modules 1, 2, and 3, voltage sensor contacts 8-10 open to de-energize line interposing relay K3. Contacts K3 (1-7) close to connect battery positive from the B+ terminal (TB1-B+) through voltage module 5 (18-16), through K3 (1-7) to terminal 9 of the start-stop time delay module 7. After a time delay, module 7 energizes relay K7 through start suppressor control 21 (16-20) and module 7 (21-2). Relay K7 (4-7) contacts close to connect B+ from TB1 B+ to the remote terminal TB1-RMT.

Two-Wire Starting

The B+ signal on the remote terminal (RMT) signals the generator set to start.

Three-Wire Starting

The B+ signal on the remote terminal feeds terminal 10 on the 2 to 3 wire start converter plug-in module 9. With battery positive on terminal 10, module 9 closes the circuit between terminals 15 and 4 grounding output terminal 3. It also opens the generator set stop circuit by removing ground from TB1-2. The generator starts and runs.

Whenever the generator set operates, it energizes the running time meter on the meter-lamp panel. Generator line A (drawing 626-0375) supplies power through terminal TB7-6 (drawing 626-0364) and to running time meter M12-1. Generator line B (drawing 626-0375) supplies power through TB7-7 (drawing 626-0364) and to M12-2 to complete the circuit.

As the generator reaches rated speed, generator output voltage to transfer switch emergency terminals A and B (drawing 626-0375) through TB7-6 and -7 (drawing 626-0445) energizes the primary of step-down transformer T3. Transformer T3 terminals X1 and X2 feed a nominal 40 volts into generator voltage sensor module 4 terminals 12 and 15. When this output voltage exceeds the set point of the voltage sensor module 4, module 4 contacts (8-10) close the circuit through generator interposing relay K4 coil to terminal 12 of transfer time delay module 8. Battery positive voltage feeds through terminals 16 and 18 of the voltage regulator module 5 to module 8 terminal 21. Module 8 delays closing of the solid state switch 8 (12-21) to energize relay K4. Once the time delay has completed, relay K4 energizes to close the circuit from generator line A through TB7-6 (drawing 626-0375), TB6-6 (drawing 626-0445), K4 (4-7), K3 (2-8), TB6-8, TB7-8 (drawing 626-0375), interposing relay K1, and to emergency line B. Interposing relay

K1 is energized to open its normally-closed K1 contacts (3-4, 7-8) and close its normally-open K1 contacts (1-2, 5-6).

This connects generator power from emergency lines A and B, through the closed K1 contacts, actuator switch S1, switch S5 closed contacts, and through circuit breaker CB1 to the M1 windings. The linear actuator M1 operates to disconnect the load from the normal side and connect the load to the emergency side.

Normally-open S5 contacts close to complete a circuit from emergency line B, contacts K1 (1-2), TB31-3, TB31-6, to TB7-12 (drawing 626-0364), T12-7 (COM), through T12 primary, to TB7-8, TB6-8 (drawing 626-0445), contacts K3 (2-8), K4 (4-7), TB6-6, TB7-6 (drawing 626-0375), and to emergency line A. The primary of T12 (drawing 626-0364) induces a voltage in the secondary windings to light the "EMERGENCY" lamp DS12 on the meter-lamp panel.

Both the red emergency lamp and green normal lamp are 56-volt lamps operating on 40 volts.

Momentary Power Outage

A very short duration power outage or dip of normal line voltage can drop out line interposing relay K3 (drawing 626-0445). Contacts K3 (1-7) close to signal the start-stop time delay module 7 to start timing. However, if the voltage dip or power outage is shorter than the time delay and the start-up time of the generator set, normally-closed contacts K4 (2-8) will bypass any time delay in retransfer to re-energize relay K3 through the voltage sensors to keep the load on the normal line. Contacts K3 (1-7) open to reset the start-stop time delay.

AREA PROTECTION

Onan automatic transfer switches have provisions for connecting area protection equipment. The normally closed output terminal of the area protection equipment connects to TB1-4 and -5 (drawing 626-0445). A jumper between TB1-4 and -5 must be removed during wiring connections before the protection equipment will operate the circuit.

The area protection equipment opens the circuit between TB1-4 and -5 which removes the AC input voltage from voltage sensor module 1 (12-15). Voltage sensor module 1 opens the circuit through contacts (8-10). Line interposing relay K3 is de-energized as described under *Power Outage*.

When the area protection equipment closes the circuit between TB1-4 and -5 (drawing 626-0445) again, the voltage sensor module 1 closes a circuit through terminals 8 and 10 to pick up line interposing relay K3 again as described in *Restoration of Normal Line*.

RESTORATION OF NORMAL LINE

When the normal line voltage returns, it energizes step-down transformers T2, T4, and T5 (drawing 626-0445). Transformer output voltage from terminals X1 and X2 feeds voltage sensor modules 1, 2, and 3.

Modules 1, 2, and 3 contacts (8-10) close to complete the circuit from ground to relay K3 and to transfer-retransfer time delay module 8 terminal 8. Module 8 starts timing because it already has battery positive from auto-manual switch S3, contacts K6 (1-7), voltage module 5 (4-8), switch S1 (2-3), and terminal TB1-B+. When the time delay ends, module 8 connects B+ from terminal 2 to terminal 6 to pick up relay K3. Normally-closed contacts K3 (1-7) open to remove battery positive from the start-stop time delay module 7. Module 7 initiates the stop time delay. Contacts K3 (2-8) open to break a circuit through TB6-8 and TB7-8 (drawing 626-0445) to de-energize transfer switch interposing relay K1 (drawing 626-0375). Normally-open K1 contacts on the emergency side open, normally-closed K1 contacts on the normal side close to connect the normal power lines A and B to the linear motor M1 windings through TB31-1 and -2. Linear motor M1 opens the emergency-side contacts and closes the normal-side contacts to connect the load to the normal source. The mechanical interlock latches over center to hold the contacts closed. Limit switch S2 contacts open to remove power from motor M1.

The generator set continues to run until the start-stop time delay module 7 (drawing 626-0445) times out to de-energize start relay K7. K7 contacts (4-7) open to remove B+ from the remote (RMT) line to stop the generator set for two-wire start generator sets. For a three-wire start generator set, 2 to 3 wire converter module 9 removes ground from TB1 terminal 3 and puts ground on TB1 terminal 2 to stop the generator set.

SIMULATION OF POWER OUTAGE

To ensure that the equipment is ready to perform if a power outage occurs, the operator should periodically simulate a power outage. The Onan automatic transfer switch has two switches to provide a choice of testing or exercising the generator set with load or without load.

Without Load

To test the generator set without load, place selector switch S2 in the WITHOUT LOAD (closed) position (drawing 626-0445). Then place the test transfer switch S1 in the TEST position. Battery positive connected through test switch S1 (1-2) and selector switch S2 (2-3) to the remote (RMT) line signals the generator set to start and run unloaded. To stop the generator set, return the test switch to the NORMAL position.

With Load

To test the generator set under actual operating conditions, set selector switch S2 to the WITH LOAD (open) position. Then move the test transfer switch S1

from NORMAL position to TEST position. Relay contacts K3 (1-7) close to energize start-stop time delay module 7. After the time delay ends, module 7 closes contacts (2-21) to energize relay K7. Contacts K7 (4-7) close to connect B+ to the remote terminal (TB1-RMT) which initiates engine cranking.

As the generator comes up to speed, generator output voltage to transfer switch emergency terminals A and B (drawing 626-0375) through TB7-6 and -7 (drawing 626-0445) energizes the primary of step-down transformer T3. Transformer T3 terminals X1 and X2 feed a nominal 40 volts into generator voltage sensor module 4 terminals 12 and 15. When this output voltage exceeds the set point of the voltage sensor module 4, module 4 contacts (8-10) close the circuit through generator interposing relay K4 coil to terminal 12 of transfer time delay module 8. Battery positive voltage feeds through terminals 16 and 18 of the voltage regulator module 5 to module 8 terminal 21. Module 8 delays closing of the solid state switch 8 (12-21) to energize relay K4. Once the time delay has completed, relay K4 energizes to close the circuit from generator line A through TB7-6 (drawing 626-0375), TB6-6 (drawing 626-0445), K4 (4-7), K3 (2-8), TB6-8, TB7-8 (drawing 626-0375), interposing relay K1 to emergency line B. Interposing relay K1 is energized to open its normally-closed K1 contacts (3-4, 7-8) and close its normally-open K1 contacts (1-2, 5-6).

This connects generator power from emergency lines A and B, through the closed K1 contacts, actuator switch S1, switch S5 closed contacts, and circuit breaker CB1 to the M1 windings. The linear actuator M1 operates to disconnect the load from the normal side and connect the load to the emergency side.

To end the test and retransfer the load back to the normal line, move test switch S1 to NORMAL (drawing 626-0445). This connects battery positive from TB1-B+, S1 (2-3), M1 (4-5), A5 (4-8), contacts K6 (1-7), switch S3 (1-2), to transfer-retransfer time delay 8 terminal 2. Module starts timing because it already has battery negative from modules 1, 2, and 3 contacts (8-10). When the time delay ends, module 8 connects B+ from terminal 2 to terminal 6 to pick up relay K3. Normally-closed contacts K3 (1-7) open to remove battery positive from the start-stop time delay module 7. Module 7 initiates the stop time delay. Contacts K3 (2-8) open to break a circuit through TB6-8 and TB7-8 (drawing 626-0445) to de-energize transfer switch interposing relay K1 (drawing 626-0375). Normally-open K1 contacts on the emergency side open. Normally-closed K1 contacts on the normal side close to connect the normal power lines A and B to the linear motor M1 windings through TB31-1 and-2. Linear motor M1 opens the emergency-side contacts and closes the normal-side contacts to connect the load to the normal source. The mechanical interlock latches over center to hold the contacts closed. Limit switch S2 contacts open to remove power from motor M1.

The generator set continues to run until the start-stop time delay module 7 (drawing 626-0445) times out to de-energize start relay K7. K7 contacts (4-7) open to remove B+ from the remote (RMT) line to stop the generator set for two-wire start generator sets. For a three-wire start generator set, 2 to 3 wire converter module 9 removes ground from TB1 terminal 3 and puts ground on TB1 terminal 2 to stop the generator set.

EXERCISER CLOCK

The exerciser clock starts and stops the generator set automatically for periodic test operations. Drawing 626-0445 shows the exerciser clock M1 motor circuit connected to step-down transformer T1 terminals X4 and X5. Transformer T1 primary connects to the normal side of the transfer switch through disconnect plug terminals X and Y.

The exerciser clock cam-operated switch contacts M1-3, -4 and -5 connect to test transfer switch S1 and selector switch S2. The M1 switch contacts are shown in the normal position with the contacts (3-5) open and contacts (4-5) closed. After the operator selects the mode, the exerciser clock automatically exercises the generator set.

Exercise Without Load

With switch S2 in the WITHOUT LOAD (closed) position, the exerciser clock contacts M1 (3-5) close to complete the circuit from B+ through switch contacts S1 (2-3), M1 (3-5), S2 (2-3) to the remote (RMT) terminal. The generator set starts and runs as previously described under *SIMULATION OF POWER OUTAGE (WITHOUT LOAD)* until the exerciser clock contacts M1 (3-5) open at the end of the exercise period.

Exercise With Load

With selector switch S2 in the WITH LOAD (open) position, exerciser clock contacts M1 (4-5) open the circuit to remove battery positive from line interposing relay K3. Relay K3 drops out the same as it does if there is a power outage and the generator set starts and runs as long as the exerciser clock contact remains open.

Preheat Time Delay

The preheat time delay is optional on OT-E automatic transfer switches. It provides time for operation of the diesel engine glow plugs before remote signal for engine cranking.

Relay K7 is energized by receiving battery positive through start-stop time delay module 7, the start suppressor control 21, voltage module 5 (16-18), and from TB1-B+ (drawing 626-0445). Contacts K7 (4-7) close to connect battery positive to TB1-RMT and to the 2 to 3 wire converter module 9. Module 9 connects ground to preheat time delay module 16 (terminal 5). Module 16 grounds TB1-H to complete the preheat circuit and grounds terminal 14 of module 9 to inhibit cranking during the preheat circuit period.

When the preheat time delay has ended, module 16

removes the inhibit ground circuit from module 9 (terminal 14). Module 9 connects battery ground to TB1-3 (start circuit) and removes ground from TB1-2 (stop circuit). The generator set starts and runs.

As the generator comes up to speed, voltage sensor module 4 senses generator output and closes a circuit to 2 to 3 wire converter module 9 (terminals 8 and 9). Module 9 removes ground from TB1-3 to stop cranking. Module 4 also completes ground to terminal 9 of preheat time delay module and opens the preheat circuit.

PUSH TO RETRANSFER AND SELECTOR SWITCHES

Some automatic transfer switch installations require that the generator set continue to supply power until a retransfer signal is manually initiated after restoration of normal power. Some installations also require a selector switch for choice of automatic retransfer or manually-initiated retransfer through a push-to-retransfer switch. Drawing 626-0445 shows both the manual-auto selector switch S3 and push-to-retransfer switch S4.

Manual Retransfer

With S3 selector switch in MANUAL position, relays K3 and K5 drop out on a voltage dip or a commercial power outage to initiate generator set starting. If the normal line restores voltage before the generator set can build up voltage, normally-closed contacts K4 (2-8) will again energize relay K3 to keep the load on the line.

If the power outage continues, voltage sensor module 4 energizes relay K4 through bypass module 8 contacts (12-21). Relay contacts K4 (2-8) open and contacts K5 (4-7) remain open to prevent K3 from picking up on normal power restoration.

To initiate a retransfer on normal power restoration, the operator must push retransfer switch S4 bypassing contacts K5 (6-9) to energize retransfer relay K5 through the voltage sensors. Contacts K5 (6-9) close to "seal in" relay K5. Contacts K5 (4-7) close to energize relay K3 through automatic-manual switch contacts S3 (2-3) and voltage sensor modules 1, 2, and 3. Relay contacts K3 (2-8) open and contacts K3 (6-9) close to transfer the load from the generator set to the normal line. See *Restoration of Normal Line*. Contacts K3 (1-7) open to initiate the stop time delay.

Automatic Position

With automatic-manual transfer selector switch S3 in the AUTOMATIC position, relay K3 will pick up on normal power restoration through switch contacts S3 (1-2), module 8 terminals 2 and 6, and voltage sensor modules 1, 2, and 3. Relay K3 picks up to open K3 (2-8) and close K3 (6-9) to transfer the load from the generator set to the normal line. See *Restoration of Normal Line*. Contacts K3 (1-7) open to initiate stopping of the generator set.

AC OVERVOLTAGE SENSOR

Overvoltage sensors monitor the commercial line and start the generator set in case the commercial line exceeds the set voltage. Drawing 626-0445 shows three voltage sensor modules 13, 14 and 15 monitoring a three-phase system. The solid state switches of all three voltage sensors connect in parallel so that if any one line voltage exceeds the voltage setting, the voltage sensor will close its circuit between terminals (8-10) to energize overvoltage relay K6. Contacts K6 (1-7) open to drop relay K3 and contacts K3 (1-7) close to energize the start-stop time delay module 7. Time delay module 7 contacts (2-21) close to energize start relay K7. Contacts K7 (4-7) close to energize the remote (RMT) line and start the generator set. When the generator set comes up to speed and voltage, relay K4 closes contacts K4 (4-7) to energize relay K1 through contacts K3 (2-8), TB6-8 (drawing 626-0375), and TB7-8. Relay contacts K1 (1-2) and K1 (5-6) close to connect emergency lines A and B to linear motor M1 through TB31-2 and TB31-3, transferring the load from the normal line to the generator set. See *Power Outage*.

When the commercial line voltage returns to normal, the voltage sensor opens the circuit between terminals (8-10) to drop relay K6 (drawing 626-0445). Contacts K6 (1-7) close again to allow relay K3 to be energized through plug-in module 8 and the undervoltage sensors. See *Restoration of Normal Line*.

BATTERY VOLTAGE SENSOR

The battery voltage sensor module 10 monitors the battery charging system. If the battery charger exceeds a safe float voltage, the high battery voltage lamp DS14 lights. If the battery float charger fails to charge, low battery voltage lamp DS13 lights.

Drawing 626-0445 shows module 10 terminal 12 connected to ground and terminal 19 connected to battery positive. If the battery charger exceeds the high battery voltage sensor setting, the sensor lights the high battery voltage lamp DS14 through a circuit from module 10 contact 21, TB6-3 (drawing 626-0375), TB7-3 (drawing 626-0364), DS14, TB7-5 (drawing 626-0375), TB6-5 to ground. Contacts connected to TB2 terminals 1 and 2 close (drawing 626-0445). Contacts connected to TB2 terminals 2 and 3 open. If the battery charger has failed to charge, battery voltage will drop below the battery voltage sensor setting and light the low battery voltage lamp DS13 through a circuit from module 10 contact 17, TB6-4 (drawing 626-0375), TB7-4 (drawing 626-0364), DS13, TB7-5 (drawing 626-0375), and TB6-5 to ground. The battery voltage sensor closes the contacts connected to TB2 terminals 4 and 5 (drawing 626-0445) and opens the contacts connected to TB2 terminals 5 and 6 to indicate a low battery voltage condition.

AUXILIARY CONTACTS

Small switches mounted on the normal and emergency side of the transfer switch provide dry contacts for external alarm or control circuits (drawing 626-0375). Each switch has one normally-open contact and one normally-closed contact.

OTs WITH CONTROL ACCESSORY GROUPS 51-55

NORMAL OPERATION

Under normal conditions, the normal power source supplies power to the load from normal lines A, B, and C, and through the normal-side contacts shown in schematic 626-0375. Linear motor M1 is originally energized from normal line A, closed K1 contacts (7-8), TB31-2, disconnect switch S1, CB1, motor M1 windings, normally-open limit switch S2, TB31-1, contacts K1 (3-4), to normal line B. Once the transfer switch is picked up by the normal line side, it is mechanically held in that position and limit switch S2 normally-closed, held-open contacts disconnect power from motor M1.

In the normal position, S2 switch contacts are closed to light the normal lamp DS11 through a circuit completed from normal line B, contacts K1 (3-4), TB31-1, switch S2, TB31-5, TB7-10 (drawing 626-0364), through transformer T11 primary windings, TB7-11 (drawing 626-0375), to normal line A. The primary of T11 (drawing 626-0364) induces a voltage in the secondary windings to light "NORMAL" lamp DS11 on the meter-lamp panel.

POWER OUTAGE

When a power outage occurs to the normal power source, the voltage from lines A, B, and C (drawing 626-0375), through disconnect plug terminals X, Y, and Z disappears (drawing 626-0075). Relay K6 is de-energized and contacts K6 (3-5) open to de-energize line interposing relay K3 and start time delay relay K7.

Two-Wire Starting

Start time delay relay K7 begins its time delay. When the time delay ends, contacts K7 (1-5) close to connect battery positive from TB1-B+, through selector switch S2 (1-2), to the remote start terminal TB1-RMT. The generator set cranks and runs.

Three-Wire Starting

Start time delay relay K7 (drawing 626-0175) begins its time delay. When the time delay ends, contacts K7 (1-5) close to connect battery negative from TB1-1, through selector switch contacts S2 (1-5), M1 (4-5), K7 (1-5), K4 (2-1), K5 (1-2), to TB1-H and TB1-3. The generator set cranks and runs.

Whenever the generator set operates, it energizes the running time meter on the meter-lamp panel. Generator line A (drawing 626-0375) supplies power through terminal TB7-6 (drawing 626-0364) and to running time meter M12-1. Generator line B (drawing 626-0375) supplies power through TB7-7 (drawing 626-0364) and to M12-2 to complete the circuit.

As the generator comes up to speed, generator output completes a circuit from emergency line A (drawing 626-0375), TB7-6, TB6-6 (drawing 626-0075), TB6-11, TB6-12, relay K4, resistor R4, TB6-7, TB7-7 (drawing 626-0375), to generator line B. Relay K4 is energized (drawing 626-0075) to close contacts K4 (3-4) and open contacts K4 (1-2) and K4 (5-6).

A circuit is now complete from TB6-6, through contacts K4 (3-4), transfer time delay K13, TB6-7 (drawing 626-0375), to emergency line B. Transfer time delay K13 is energized and starts its time delay cycle (drawing 626-0075). When the time delay ends, contacts K13 (1-5) close to complete a circuit through normally-closed K3 contacts (1-3), TB6-8, TB7-8 (drawing 626-0375), relay K1, and emergency line B. Interposing relay K1 is energized to open contacts K1 (3-4) and K1 (7-8), and to close contacts K1 (1-2) and K1 (5-6). This completes a circuit from emergency line A, through K1 contacts (5-6), TB31-2, actuator switch S1, CB1, linear motor M1 windings, closed S5 switch contacts, TB31-3, closed K1 contacts (1-2), and to emergency line B. Linear motor M1 operates to disconnect load from the normal side and connect the load to the emergency side.

Normally-open S5 contacts close to complete a circuit from emergency line B, contacts K1 (1-2), TB31-3, S5 contacts, TB31-6, TB7-12 (drawing 626-0364), through the primary of transformer T12, TB7-8 (drawing 626-0375), TB6-8 (drawing 626-0075), contacts K3 (1-2), K13 (1-5), contacts K4 (3-4), TB6-6, TB7-6 (drawing 626-0375), to emergency line A. This circuit through T12 primary windings (drawing 626-0364) induces a voltage in the secondary windings to light "EMERGENCY" lamp DS12.

AREA PROTECTION

Onan automatic transfer switches have provisions for connecting area protection equipment. The normally-closed output terminal of the area protection equipment connects to terminals TB1-4 and -5 (see drawing 626-0075). A jumper between these two terminals must be removed before the protection equipment will operate the circuit.

The area protection equipment opens the circuit between TB1-4 and -5 which removes AC input voltage from relays K3 and K7. Relays K3 and K7 are de-energized as described under *Power Outage.*

When area protection equipment closes the circuit between TB1-4 and -5, relay K3 is energized as described under *Restoration of Normal Line.*

RESTORATION OF NORMAL LINE

When the normal line voltage returns, a circuit is complete from normal line B (drawing 626-0375), disconnect plug terminal Y (drawing 626-0075), relay K6, disconnect plug terminal Z (drawing 626-0375), and to normal line C. Relay K6 energizes and closes

contacts K6 (3-5) (drawing 626-0075) to complete a circuit from normal line A (drawing 626-0375), to plug terminal X (drawing 626-0075), K10 retransfer time delay motor, contacts K10 (TDO), contacts K6 (3-5), TB1-4 and -5, test transfer switch S1, disconnect plug terminal Y (drawing 626-0375), and to line B. Time delay K10 energizes (drawing 626-0075), and after the time delay period ends, closes contacts K10 (7-8) to complete the circuit to energize relay K3 and to energize stop time delay K9 through contacts K9 (TDO).

Relay K3 energizes (drawing 626-0075) and opens K3 contacts (1-3) to break the circuit through TB6-8, TB7-8 (drawing 626-0375), to relay K1. Relay K1 de-energizes to open contacts K1 (1-2) and K1 (5-6), and to close contacts K1 (3-4) and K1 (7-8). This completes a circuit from normal line A through K1 contacts (7-8), TB31-2, actuator switch S1, CB1, linear motor M1 windings, closed limit switch S2 contacts, TB31-1, contacts K1 (3-4), to normal line B. Linear motor M1 opens the emergency-side contacts and closes the normal-side contacts to connect the load to the normal source. The mechanical interlock locks over center to hold the normal contacts closed. Limit switch S2 normally-closed contacts open to remove power from linear motor M1.

After the stop time delay period ends, time delay motor K9 closes contacts K9 (7-8) to complete the circuit to energize relay K7 (drawing 626-0075). Contacts K7 (1-5) open to stop a two-wire start generator set by removing B+ from the RMT terminal. To stop a three-wire start generator set, contacts K7 (1-5) open (drawing 626-0175) to remove battery ground from TB1-H and -3, and contacts K7 (3-5) close to place battery ground on TB1-2.

SIMULATION OF POWER OUTAGE

To ensure the equipment is ready to assume load properly if an actual power outage occurs, the operator should periodically simulate a power outage. Opening test transfer switch S1 de-energizes relays K3 and K7 as described under *Power Outage*.

To end the test, move test transfer switch S1 back to NORMAL (drawing 626-0075). This closes the circuit to energize relay K3 as described under *Restoration of Normal Line*.

EXERCISER CLOCK

For OT-C and OT-D Models

The exerciser clock starts and stops the generator set automatically for periodic test and exercise operations without load. The exerciser clock is connected to commercial power lines A and B through disconnect plug terminals X and Y. See drawing 626-0075. With 480- and 600-volt systems, the exerciser is connected to a step-down transformer.

After the operator selects the desired exercise periods, the exerciser clock automatically exercises the generator set. Cam-operated switch contacts M1 (3-5) connect battery positive (B+) to the remote start terminal (RMT) to initiate engine cranking and starting. M1 contacts are shown in the normal position.

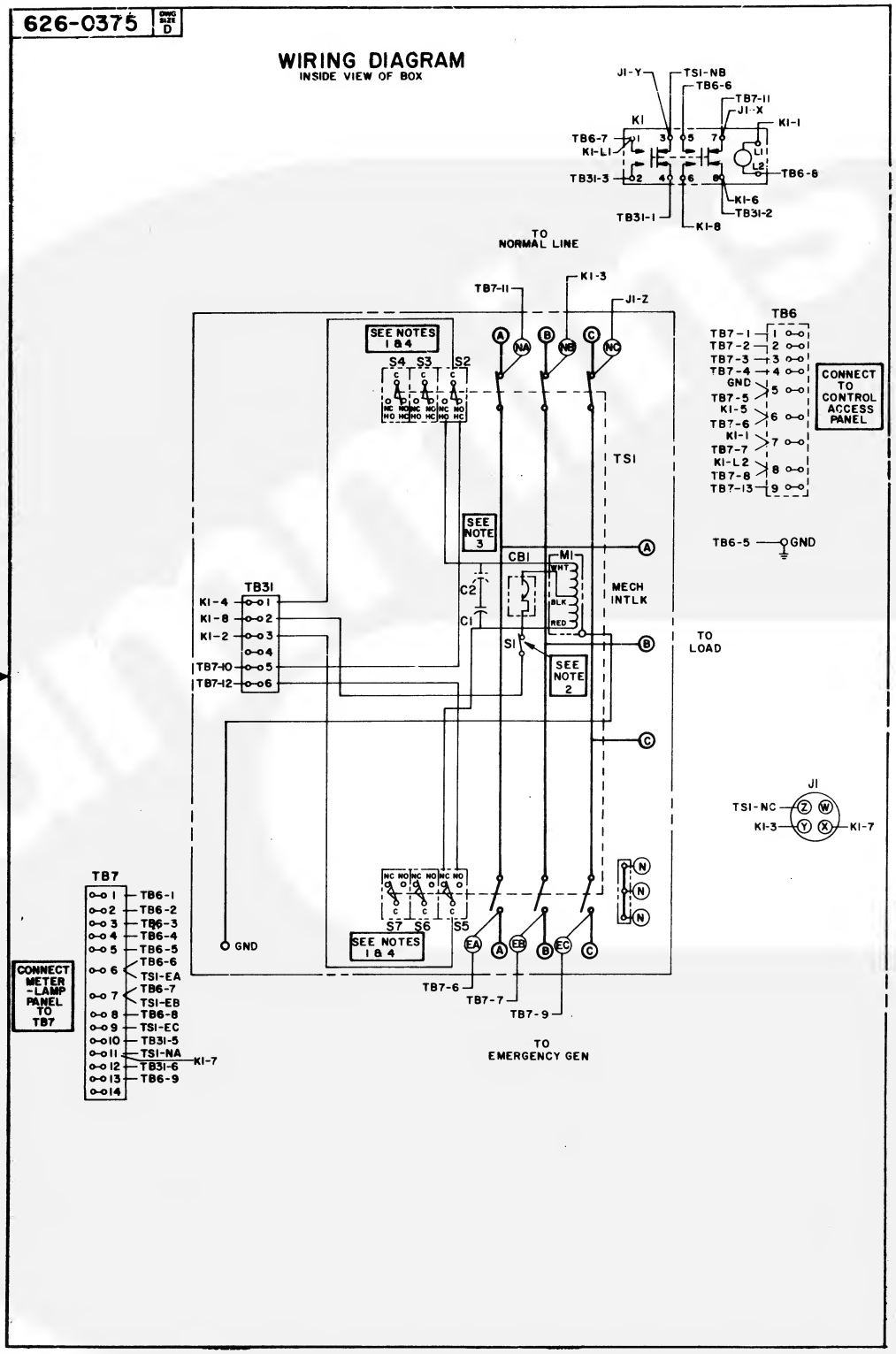
For OT-E Models

The exerciser clock starts and stops the generator set automatically for periodic test and exercise operations without load. The exerciser clock is connected to commercial power lines A and B through disconnect plug terminals X and Y. See drawing 626-0175. With 480- and 600-volt systems, the exerciser is connected to a step-down transformer.

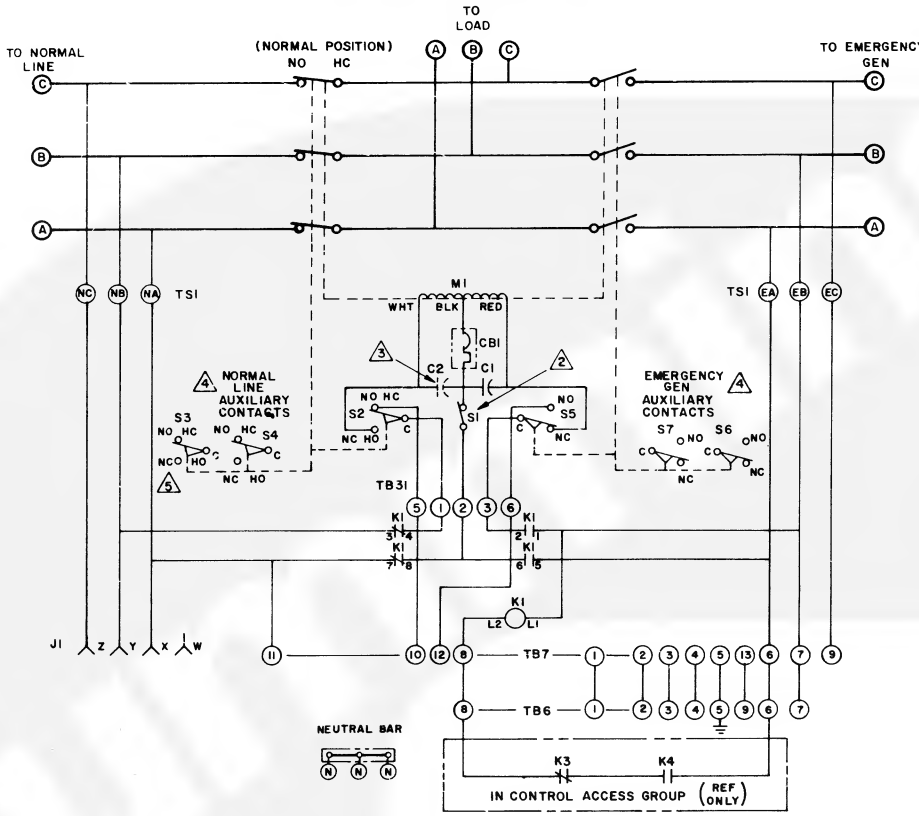
After the operator selects the desired exercises periods, the exerciser clock automatically exercises the generator set. Cam-operated switch contacts M1 (5-3) connect battery ground from TB1-GND, through selector switch S2 (1-5), to contacts K4 (2-1), K5 (1-2), TB1-H, and to TB1-3 to initiate engine cranking and starting. M1 contacts are shown in the normal position.

AUXILIARY CONTACTS

Small switches mounted on the normal and emergency side of the transfer switch provide dry contacts for external alarm or control circuits (drawing 626-0375). Each switch has one normally-open contact and one normally-closed contact.


626-0375
DWG SIZE D
WIRING DIAGRAM
INSIDE VIEW OF BOX
J1-Y
TSI-NB
TB6-6
TB7-11
J1-X
K1
K1-1
TB6-7
K1-L1
TB3I-3
TB6-8
K1-6
TB3I-1
TB3I-2
K1-8
TO NORMAL LINE
TB7-11
K1-3
J1-Z
TB6
TB7-1
TB7-2
TB7-3
TB7-4
GND
TB7-5
K1-5
TB7-6
K1-1
TB7-7
K1-L2
TB7-8
TB7-13
CONNECT TO CONTROL ACCESS PANEL
TB6-5
GND
SEE NOTES 1 & 4
S4 S3 S2
TS1
SEE NOTE 3
CB1
M1
WHT
BLK
RED
MECH INTLK
C2
C1
S1
SEE NOTE 2
TO LOAD
TB3I
K1-4
K1-8
K1-2
TB7-10
TB7-12
J1
TS1-NC
K1-3
K1-7
TB7
CONNECT METER -LAMP PANEL TO TB7
TB6-1
TB6-2
TB6-3
TB6-4
TB6-5
TB6-6
TS1-EA
TB6-7
TS1-EB
TB6-8
TS1-EC
TB3I-5
TS1-NA
TB3I-6
K1-7
TB6-9
GND
S7 S6 S5
SEE NOTES 1 & 4
TB7-6
TB7-7
TB7-9
TO EMERGENCY GEN

SCHEMATIC DIAGRAM



PARTS LIST				
REF DES	PART NO	SYM SIZE	QTY	DESCRIPTION
JI	323-0500	A	REF	RECEPTACLE
KI	307-1671	P	1	RELAY-INTERPOSING (208-240V)
	307-1672	P	1	RELAY-INTERPOSING (440-480V)
TB7	338-1049	D	1	WIRING HARNESS (-01 THRU -08)
	338-1190	D	1	WIRING HARNESS (-09 THRU -12)
	338-1060	D	1	WIRING HARNESS (-13 THRU -18)
	332-1697	A	REF	TERMINAL BLOCK
	332-1698	A	1	MARKER STRIP
TSI	306-1708	D	1	TRANSFER SWITCH (-01)
	306-1711	D	1	TRANSFER SWITCH (-02)
	306-1728	D	1	TRANSFER SWITCH (-03)
	306-1731	D	1	TRANSFER SWITCH (-04)
	306-1866	D	1	TRANSFER SWITCH (-05)
	306-1869	D	1	TRANSFER SWITCH (-06)
	306-1886	D	1	TRANSFER SWITCH (-07)
	306-1889	D	1	TRANSFER SWITCH (-08)
	306-0849	D	1	TRANSFER SWITCH (-09)
	306-0851	D	1	TRANSFER SWITCH (-10)
	306-0861	D	1	TRANSFER SWITCH (-11)
	306-0863	D	1	TRANSFER SWITCH (-12)
	306-0873	D	1	TRANSFER SWITCH (-13)
	306-0875	D	1	TRANSFER SWITCH (-14)
	306-0885	D	1	TRANSFER SWITCH (-15&17)
	306-0887	D	1	TRANSFER SWITCH (-16&18)
C	301-5405	D	1	CABINET ASSY (-01 THRU-08)
B	301-4822	D	1	CABINET ASSY (-09 THRU-12)
	301-4823	D	1	CABINET ASSY (-13 THRU-16)
	301-5671	C	1	CABINET ASSY (-17 & -18)
	98-1269	A	1	NAMEPLATE-CONTROL
	98-2799	A	1	LABELS-TERMINAL BLOCKS
	406-0383	A	2	HINGE-PIN
	508-0177	P	2	WASHER-NYLON
	301-3524	B	1	PLATE-STRIKER (-01 THRU-08)
	406-0370	A	1	PIN-LATCH
	332-1356	P	2	CLAMP-LOOP
	332-1414	-	6	CLAMP-LOOP
	332-0050	-	1	CLAMP-LOOP
	332-0050	-	5	CLAMP-LOOP (-09 THRU -18)

NOTES:

1. TRANSFER SWITCH MECHANICALLY HELD BOTH SIDES SHOWN LOCKED IN NORMAL LINE-EMERGENCY GEN SIDE OPEN, NORMAL LINE SHOWN DE-ENERGIZED
   - CI & 2 __ CAPACITOR
   - CBI ___ CIRCUIT BREAKER
   - MI ____ LINEAR ACTUATOR
   - SI ____ DISCONNECT SWITCH
   - S2 ____ CUTOFF & NORMAL LAMP SWITCH
   - S3,4,6 & 7 AUX SWITCH CUSTOMER CONNECTION
   - S5 ____ CUTOFF & EMERGENCY LAMP SWITCH
   - TB3I ___ TERMINAL BLOCK-CONTROL
   - N _____ NEUTRAL BAR

2. DISCONNECT SWITCH: FOR MANUAL OPERATION OF TRANSFER SWITCH, THROW SWITCH TO "OFF."
   CAUTION:
   RETURN TRANSFER SWITCH TO ORIGINAL POSITIONS BEFORE SWITCHING TO "ON."
   SWITCH MUST BE LEFT IN ON POSITION EXCEPT FOR MANUAL SWITCHING

3. C2: CONNECT IN SERIES WITH CI ON 480V ONLY

4. AUXILIARY CONTACT RATINGS;
   25 AMPS 480 VAC
   1HP, 125VAC; 2HP, 250VAC
   PILOT DUTY. 750VA, 277VAC

5. NO HC DESIGNATES NORMALLY OPEN, HELD CLOSED
   NC HO DESIGNATES NORMALLY CLOSED, HELD OPEN

TRANSFER SWITCH CABINET ASSY: D

TRANSFER SW MECHANICALLY HELD BOTH SIDES
WITH MANUAL OPERATORS
AUXILIARY CONTACTS, NORMAL LINE & EMERGENCY GEN SIDE (QTY 2 FOR EACH)

THIS INFORMATION IS FOR MANUFACTURES USE ONLY								CABINET HEIGTH	
LINE TO LINE VOLTAGE 50-60Hz	DASH NUMBERS PER AMP SIZE							72"	90"
	100A	150A	225A	280A	400A	600A	800A	1000A	1000A
208-240 V	-01	-03	-05	-07	-09	-11	-13	-15	-17
440-480V	-02	-04	-06	-08	-10	-12	-14	-16	-18

ER	LET	REVISION	DRN	CHK	DATE
2328	E	WAS 307-1545 & -1546	JM	CJF	3-26-80
2328	A	RMVD 233-0980 (A) QTY 1	JM	CJF	3-26-80
1230	D	ADDED -17 & -18		CJF	11-19-79
0119	C	ADDED 301-5405		CJF	8-15-79
0119	B	REM 301-4300,4323		CJF	8-15-79
	A	ADDED 233-0980		CJF	2-27-79

VOLTAGE CODE
4,64,5D,55D,4X,54X

DIVISION OF ONAN CORPORATION
Minneapolis, Minnesota

DRAWN [illegible] DATE 1-29-79 CHK CIP

MODEL NO.
OT C
OT D SPEC C
OT E

TRANSFER SW-CAB ASSY (WIRING DIAGRAM)

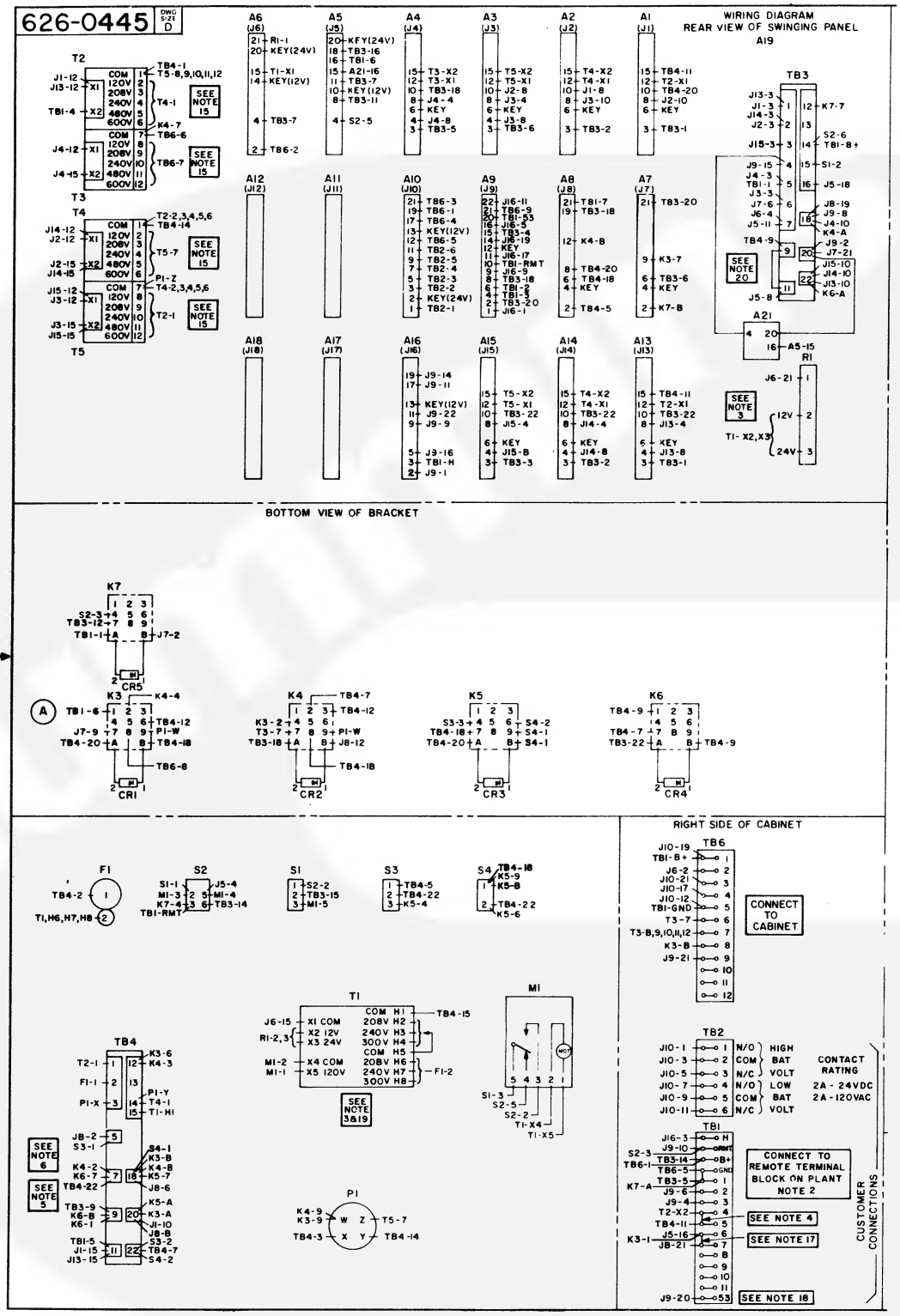
208-240V, 440-480V; 100A THRU 1000A, 3PH, 4W, 50-60Hz

SIZE D

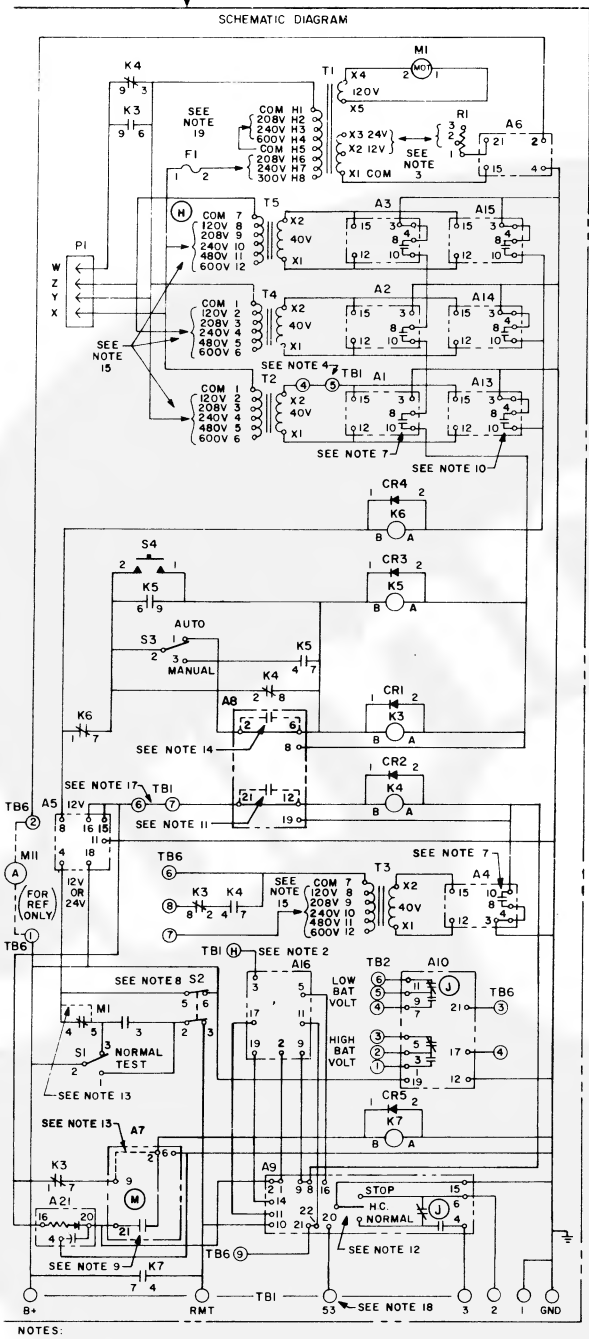
DRAWING NO. 626-0375

626-0375

626-0375


626-0445
DWG SIZE D
WIRING DIAGRAM
REAR VIEW OF SWINGING PANEL
A19
BOTTOM VIEW OF BRACKET
RIGHT SIDE OF CABINET
T2
T3
T4
T5
TB3
TB4
TB6
TB1
TB2
A21
R1
K1
K2
K3
K4
K5
K6
K7
CR1
CR2
CR3
CR4
CR5
F1
S1
S2
S3
S4
T1
M1
P1
SEE NOTE 15
SEE NOTE 20
SEE NOTE 3
SEE NOTE 6
SEE NOTE 5
SEE NOTE 3a19
CONNECT TO CABINET
CONNECT TO REMOTE TERMINAL BLOCK ON PLANT NOTE 2
SEE NOTE 4
SEE NOTE 17
SEE NOTE 18
CONTACT RATING
2A - 24VDC
2A - 120VAC
CUSTOMER CONNECTIONS

SCHEMATIC DIAGRAM



8. TEST OR EXERCISE (S2 SHOWN IN WITHOUT LOAD POSITION)
   8.1. WITH LOAD - PLANT STARTS AND TAKES OVER LOAD. PLANT RUNS FOR DURATION OF TEST OR EXERCISE PERIOD PLUS ANY TIME DELAYS
   8.2. WITHOUT LOAD - PLANT STARTS AND RUNS FOR DURATION OF TEST OR EXERCISE PERIOD

9. THIS CONTACT SYMBOLIZES A SOLID STATE SWITCH WHICH CLOSES AFTER A 0.1 SEC TO 15 SEC DELAY AND OPENS AFTER A 0.1 MIN TO 10 MIN DELAY

10. THIS CONTACT SYMBOLIZES A SOLID STATE SWITCH THAT CLOSES WHEN VOLTAGE GOES ABOVE NORMAL (A13, A14 & A15)

11. THIS CONTACT SYMBOLIZES A SOLID STATE SWITCH THAT CLOSES AFTER A DELAY OF .1 SEC TO 15 SEC DELAY ON LOAD TRANSFER

12. 2 TO 3 WIRE CONVERTER (AT E ONLY)
    THE SELECTOR SW HAS THREE POSITIONS:
    STOP - - - - - STOPS PLANT. PREVENTS STARTING. USE THIS POSITION FOR SERVICING PLANT
    NORMAL - - - ALLOWS PLANT TO START. ASSUMES LOAD IF A LINE FAILURE OCCURS.
    HAND CRANK - PREVENTS AUTOMATIC START ALLOWS STARTING & STOPPING AT THE PLANT. USE THIS POSITION FOR PLANT MAINTENANCE.

13. THIS DASHED LINE REPRESENTS A JUMPER CIRCUIT THAT MUST BYPASS A CONTACT OR CLOSE A CIRCUIT TO OPERATE WITHOUT THE REFERENCED MODULE

14. THIS CONTACT SYMBOLIZES A SOLID STATE SWITCH WHICH CLOSES AFTER A .5 MIN TO 30 MIN DELAY ON RETRANSFER

15. WIRE TRANSFORMERS T2,3,4 & 5 AS FOLLOWS

FOR 208V CONNECT	T4 - 1	TO T2 - 3
	T6 - 7	TO T3 - 9
	T5 - 7	TO T4 - 3
	T2 - 1	TO T5 - 9
FOR 240V CONNECT	T4 - 1	TO T2 - 4
	T6 - 7	TO T3 - 10
	T5 - 7	TO T4 - 4
	T2 - 1	TO T5 - 10
FOR 480V CONNECT	T4 - 1	TO T2 - 5
	T6 - 7	TO T3 - 11
	T5 - 7	TO T4 - 5
	T2 - 1	TO T5 - 11
FOR 600V CONNECT	T4 - 1	TO T2 - 6
	T6 - 7	TO T3 - 12
	T5 - 7	TO T4 - 6
	T2 - 1	TO T5 - 12

16. WIRING DIAGRAM SHOWS CIRCUIT AS IF ALL ADDER PACKAGES WERE INSTALLED, PLUS IT SHOWS JUMPERS REQUIRED WHEN THEY ARE NOT INSTALLED

17. TO ADD PARALLELING SWITCH BOARD TRANSFER INHIBIT CIRCUIT, REMOVE JUMPER TB1-6 & 7

18. OVERCRANK SIGNAL ON AT E ONLY. CONNECT TO TERMINAL 53 IN REMOTE ANNUNCIATOR

19. WIRE T1 TRANSFORMER AS FOLLOWS:

PRIMARY			
208V		240V	
F1-2		F1-2	
300V H8		300V H8	
240V H7		240V H7	
208V H6		208V H6	
COM H5		COM H5	
300V H4		300V H4	
240V H3		240V H3	
208V H2		208V H2	
COM H1		COM H1	
TB4-15		TB4-15	
480V		600V	
F1-2		F1-2	
300V H8		300V H8	
240V H7		240V H7	
208V H6		208V H6	
COM H5		COM H5	
300V H4		300V H4	
240V H3		240V H3	
208V H2		208V H2	
COM H1		COM H1	
TB4-15		TB4-15	

20. TO ADD OVER & UNDER FREQUENCY SENSING, REMOVE JUMPER BETWEEN TB3-9 & 11

CONTROL ACCESSORY GROUP 15
STANDARD
3 UNDER VOLTAGE SENSORS (LINE)
1 UNDER VOLTAGE SENSOR (GEN)
2 TO 3 WIRE CONVERTER (AT E ONLY)
NORMAL - TEST SWITCH
WITH LOAD - WITHOUT LOAD SW
MANUAL PUSH TO RETRANSFER
* PLUG-IN-MODULE PACKAGE'S
BATTERY CHARGER MODULE
3 OVER VOLTAGE SENSORS (LINE)
TD START-STOP
TD TRANSFER-RETRANSFER
TD PREHEAT
BATTERY VOLTAGE SENSORS
** WIRE-IN-PACKAGE'S
EXERCISER CLOCK

NOTES:
1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION UNLESS OTHERWISE NOTED
2. 2 WIRE START ON AT C & AT O CONNECT TO B+, GND & RMT
   3 WIRE START ON AT E CONNECT TO B+, 1, 2 & 3 (PLUS H ON DIESELS)
3. FOR 12V BATTERY CONNECT WIRE MARKED TI-X2, X3 RI-2, 3 BETWEEN TI-X2 & RI-2 (AT O & AT E)
   FOR 24V BATTERY CONNECT WIRE MARKED TI-X2, X3 RI-2, 3 BETWEEN TI-X3 & RI-3 (AT C)
4. TO ADD AREA PROTECTION EQUIPMENT, OR REMOTE TEST TRANSFER SWITCH, REMOVE JUMPER BETWEEN TB1-4 & 5
5. REMOVE JUMPER BETWEEN TB4-7 & 9
6. REMOVE JUMPER BETWEEN TB4-5 & 7
7. THIS CONTACT SYMBOLIZES A SOLID STATE SWITCH THAT CLOSES WHEN VOLTAGE IS NORMAL (A1, A2, A3, & A4)

PARTS LIST

REF DES	PART NO	CODE SIZE	QTY	DESCRIPTION
A1,2,3	300-0780	C	3	UNDER VOLTAGE SENSOR (LINE)
A4	300-0780	C	1	UNDER VOLTAGE SENSOR (GEN)
A5	300-0847	B	1	MODULE-VOLTAGE 12V (AT D & E)
	300-0848	B	1	MODULE-24V TO 12V CONVERTER (AT C)
A6	300-0937	B	1	MODULE-BLANK (SPARE)
*	300-0793(REF)	C	1	BATTERY CHARGER-2 AMP, 12V (AT D & E)
*	300-0794(REF)	C	1	BATTERY CHARGER-2 AMP, 24V (AT C)
A7	300-1648	B	1	BYPASS PLUG-START STOP
(B) *	300-092(REF)	C	1	TD START-STOP
				0.1 SEC TO 15 SEC DELAY ON START
				0.1 MIN TO 10 MIN DELAY ON STOP
(L) A8	300-1675	B	1	BYPASS PLUG-TRANSFER
*	300-1188(REF)	C	1	TD TRANSFER-RETRANSFER
				.1 SEC TO 15 SEC ON TRANSFER
(K)				.5 MIN TO 30 MIN ON RETRANSFER
A9	300-0937	B	1	MODULE-BLANK (SPARE) (AT C & D)
	300-0926	C	1	2 TO 3 WIRE CONVERTER (AT E)
A10	300-0937	B	1	MODULE-BLANK (SPARE)
*	300-0796(REF)	C	1	BATTERY VOLTAGE SENSOR (AT D & E)
*	300-0797(REF)	C	1	BATTERY VOLTAGE SENSOR (AT C)
A11,12	300-0937	B	2	MODULE-BLANK (SPARE)
A13,14,15	300-0937	B	3	MODULE-BLANK (SPARE)
(G) *	300-0780(REF)		3	OVER VOLTAGE SENSOR (LINE)
*				
A16	300-0937	B	1	MODULE-BLANK (SPARE)
*	300-1072(REF)	C	1	MODULE-TD PREHEAT
A17,18	300-0937	B	2	MODULE-BLANK (SPARE)
A19	300-1629	C	1	PANEL ASSY-SWINGING
A21	300-1627(REF)	B	1	CONTROL-START SUPPRESSOR
(R) (P) F1	321-0236(REF)	P	1	FUSE-1 AMP 600 V
(C)				
	321-0237(REF)	P	1	FUSE-HOLDER
K3	307-1058	B	1	RELAY-INTERPOSING LINE (12V)
K4	307-1058	B	1	RELAY-INTERPOSING GEN (12V)
K5	307-1058	B	1	RELAY-RETRANSFER (12V)
K6	307-1058	B	1	RELAY-OVER VOLTAGE LINE (12V)
K7	307-1058	B	1	RELAY-START (12V)
MI	332-1484	A	1	PLATE-CLOCK COVER
(D) * *	307-1104(REF)	B	1	CLOCK-PLANT EXERCISER (120V 50Hz)
* *	307-1102(REF)	B	1	CLOCK-PLANT EXERCISER (120V 60Hz)
P1	323-0901(REF)	A	1	PLUG-LINE DISCONNECT
R1	353-0046(REF)	A	1	RESISTOR-6 OHM (2.5 OHM TAP 75W)
S1	308-0321(REF)	P	1	SWITCH-TEST TRANSFER
S2	308-0322(REF)	P	1	SWITCH-SELECTOR
S3	308-0321	P	1	SWITCH-MANUAL & AUTO
S4	308-0175	A	1	SWITCH-RETRANSFER
T1	315-0379(REF)	B	1	TRANSFORMER-BATTERY CHARGER
T2-5	315-0374(REF)	C	2	TRANSFORMER ASSY-STEPDOWN
TB1	332-1699	A	1	MARKER STRIP
TB2	332-1516	A	1	MARKER STRIP
TB6	332-1469	A	1	MARKER STRIP
	338-1139(REF)	D	1	HARNESS-MAIN (3 SHEETS)
	338-1136	C	1	HARNESS-RETRANSFER
	338-1134	D	1	HARNESS-OVER V
	338-1135	C	1	HARNESS-BAT V
	338-1138	C	1	HARNESS-TD PREHEAT
	332-2114	-	14	PLUG-KEYING
	323-1084	P	12	GUIDES-PC BOARD
	307-1157	P	2	SPRING-RELAY HOLD DOWN
(F)	301-4727	A	2	BRACKET & FASTENER

ER	LET	REVISION	BY	CHK	DATE
7528	S	REV WIRING PER E R	JM		10-1-81
2004	C	WAS 321-0178 (REF)	JM		2-25-80
2004	R	REMOVED 321-0110	JM		2-25-80
2004	P	WAS 321-0180	JM		2-25-80
	N	ADDED QT C, D, E	JM		5-5-78
	M	REVISED A7-2 WIRING	RS	EE	5-2-78
	L	A8 WAS 0927	RS	EE	5-13-78
	K	WAS .5 SEC	RS	EE	6-13-78
	J	CLOSED CONTACTS ON A9, 10	RS	EE	6-13-78
	H	120 V WAS 20 V	RS	EE	6-13-78
	G	300-0780 QTY WAS 4	RS	EE	3-9-78
	F	301-4727 QTY WAS 1	RS	EE	3-8-78
	E	ADD TAB, -01 THRU -06	RS	EE	3-2-78
	D	MI WAS 301-3487	RS	EE	
	C	ADDED (REF) TO 321-0178	RS	EE	
	B	REM (AT D & E)	RS	EE	
	A	K3-1 WAS TO TB3-15	RS	EE	2-2-78

THIS INFORMATION IS FOR MANUFACTURERS USE ONLY

MODEL	208-240V	480-600V
AT C	-01	-04
AT D	-02	-05
AT E	-03	-06

626-0445

DASH NO | MODEL NO
AT C OT C
AT D OT D } SPEC C
AT E OT E

208, 240, 480, 600V., 3PH., 4W., 50/60Hz

Onan DIVISION OF ONAN CORPORATION Minneapolis, Minnesota

DATE 12-19-77 DR CIP CDR

CONTROL-ACCESS PANEL (WIRING DIAGRAM)

SEPIA FROM D 626-0445 SIZE D

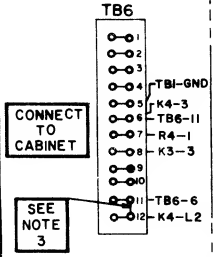
626-0445

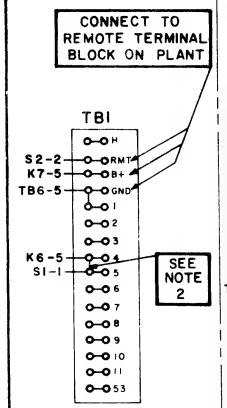
626-0445

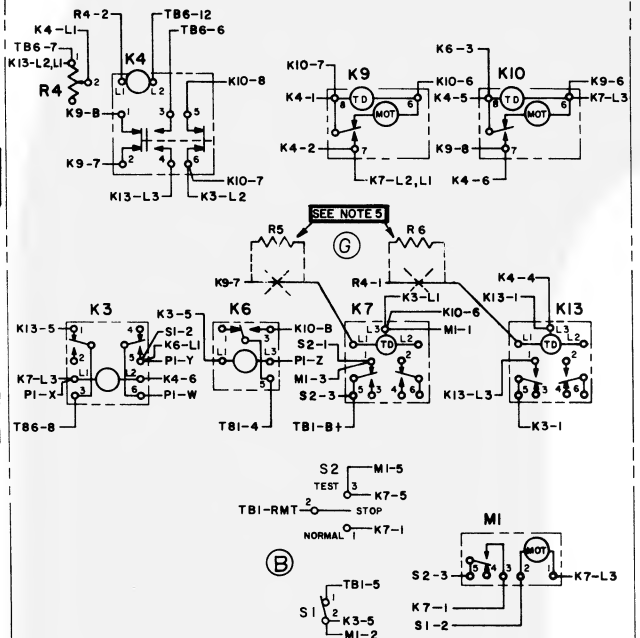
626--0075

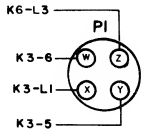
WIRING DIAGRAM
REAR VIEW OF
SWINGING PANEL

INSIDE VIEW OF
TRANSFER SW CABINET
OR
SWINGING PNL HOUSING



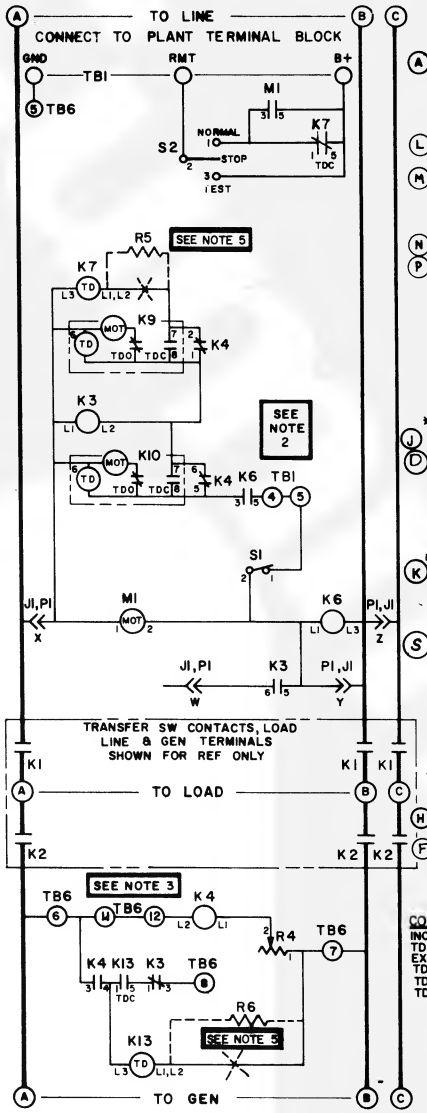






NOTES:
1. ALL COMPONENTS SHOWN IN DE-ENERGIZED POSITION, UNLESS OTHERWISE NOTED
2. TO ADD AREA PROTECTION EQUIPMENT, OR REMOTE TEST TRANSFER SWITCH, REMOVE JUMPER @ CONNECT TO TBI-4 & 5
3. TO ACTIVATE TRANSFER-INHIBIT CIRCUIT, REMOVE JUMPER @ CONNECT TO TB6-11 & 12
4. AFTER TEST, PLANT WILL RUN FOR DURATION OF TIME DELAYS
5. TO CONNECT RELAYS K7 & K13;
   (E) FOR 208V,60 HZ WIRE K9-7 TO K7-L2, WIRE R4-1 TO K13-L2
   FOR 240V,60HZ WIRE K9-7 TO K7-L1, WIRE R4-1 TO K13-L1
   FOR 208V,50HZ WIRE K9-7 TO K7-L1, WIRE R4-1 TO K13-L1
   FOR 240V,50HZ WIRE TO R5 BETWEEN K9-7 & K7-L1
   R6 BETWEEN R4-1 & K13-L1

SCHEMATIC



CONTROL ACCESSORY GROUP 55 (C)
INCLUDES ALL STANDARD ITEMS, PLUS;
TD RETRANSFER 2-60 MIN.
EXERCISER CLOCK
TD START 1-300 SEC
TD TRANSFER 1-300 SEC
TD STOP 2-60 MIN

-01	60Hz	240V
-02	50Hz	240V
-03	60Hz	208V
-04	50Hz	208V

PARTS LIST

REF. DES.	PART NO	SYM SIZE	QTY	* BULK	DESCRIPTION
K3	307-1113	B	1		RELAY-INTERPOSING LINE (208V)
	307-1083	B	1		RELAY-INTERPOSING LINE (240V)
K4	307-0664	C	1		RELAY-INTERPOSING GEN
K6	307-1114	B	1		RELAY-PHASE PROTECTION (208V)
	307-1081	B	1		RELAY-PHASE PROTECTION (240V)
K7	307-1158	B	1		RELAY-TIME DELAY ON STARTING
					TO 300 SEC ON DE-ENERGIZATION
	301-3315	A	1		MOUNTING PKG-RELAY PNL
K9	307-0724	B	1		RELAY-TIME DELAY ON STOPPING
					AFTER RETRANSFER (50/60 Hz)
	336-2318	A	1		LEAD ASSY
	336-2319	A	1		LEAD ASSY
K10	307-0724	B	1		RELAY-TD ON RETRANSFER (50/60 Hz)
	336-2309	A	1		LEAD ASSY
K13	307-1144	B	1		RELAY-TIME DELAY ON TRANSFER
					TO 300 SEC ON ENERGIZATION
	301-3315	A	1		MOUNTING PKG-RELAY PNL
	336-2310	A	1		LEAD ASSY
MI	307-1103	B	1		CLOCK-PLANT EXERCISER (60Hz)
	307-1105	B	1		CLOCK-PLANT EXERCISER (50Hz)
PI	323-0901	A	1		PLUG-LINE DISCONNECT
	301-3765	A	2		PLATE-PANEL INTERLOCK
	503-0801	–	1		HOSE
R5,6	304-0718	A	2		RESISTOR ASSY 500 Ω 25W (50HZ,240V)
R4	304-0131	A	1		RESISTOR, 750 Ω, 25W
SI	308-0069	P	1		SWITCH-TEST TRANSFER
S2	308-0138	A	1		SWITCH-SELECTOR
	332-1969	A	1		CLAMP-CABLE (USE ON PI)
	503-0721	P	1		BUSHING-RUBBER (USE ON PI)
TBI	332-1699	A	1		MARKER STRIP
TB6	332-1469	A	1		MARKER STRIP
	336-9310	A	1		LEAD
	301-3825	D	1		PANEL-SWINGING RELAY
	98-2795	D	1		SILKSCREEN-PANEL (FRONT)
	98-2796	D	1		SILKSCREEN-PANEL (REAR)
	405-1872	A	2		CLIP-DOOR
	526-0003	–	2		WASHER-FLAT
	818-0150	–	2		RIVET-DRIVE
	338-0923	E	1		WIRING HARNESS-MAIN
	301-2259	A	1		PLATE-COVER
	301-3842	A	1		PLATE-COVER
	301-4087	B	2		PLATE-COVER(VOLT SENSOR)
	301-4141	B	1		PLATE-COVER(BAT CHARGER)

626-0075

LET	REVISION	CKR.	ENGR.	DATE
K	ADDED 332-1969 & 503-0721	C/P	JM	5-24-76
J	WAS 503-0276, QTY 15	C/P	JM	5-24-76
H	WAS 301-3242 & 3843	WB	JM	4-13-76
B	CHG LOCATION OF SI & S2	CR	JM	4-1-76
G	UPDATED K3, R6	CR	JM	3-25-76
F	ADDED 301-4087 & 301-4141	CR	JM	3-25-76
E	CHG NOTE 5 FOR 50HZ	WB	JM	2-4-76
D	ADDED R5 & R6	WB	JM	2-4-76
C	GROUP NO WAS 05	WB	JM	2-2-76
B	REVERSE 1 & 3 ON S2	WB	JM	2-2-76
A	K6 WAS 307-0114	WB	JM	1-14-76

ER	LET.	REVISION	CKR.	ENGR.	DATE
2048	S	ADDED 336-9310	GT	JM	9-22-88
	R	ADDED QT C,D	C/P	JR	6-6-79
	P	DELETED 307-0723 K10		Initials	4-20-78
	N	WAS 60 Hz		Initials	4-20-78
	M	DELETED 307-0723 K9		Initials	4-20-78
	L	WAS 60 HZ	CDR	Initials	4-20-78

MODEL NO.
AT C OT C
AT D OT D (R)
208/240V, 3 PH, 4W, 50/60 Hz

Onan DIVISION OF ONAN CORPORATION Minneapolis, Minnesota

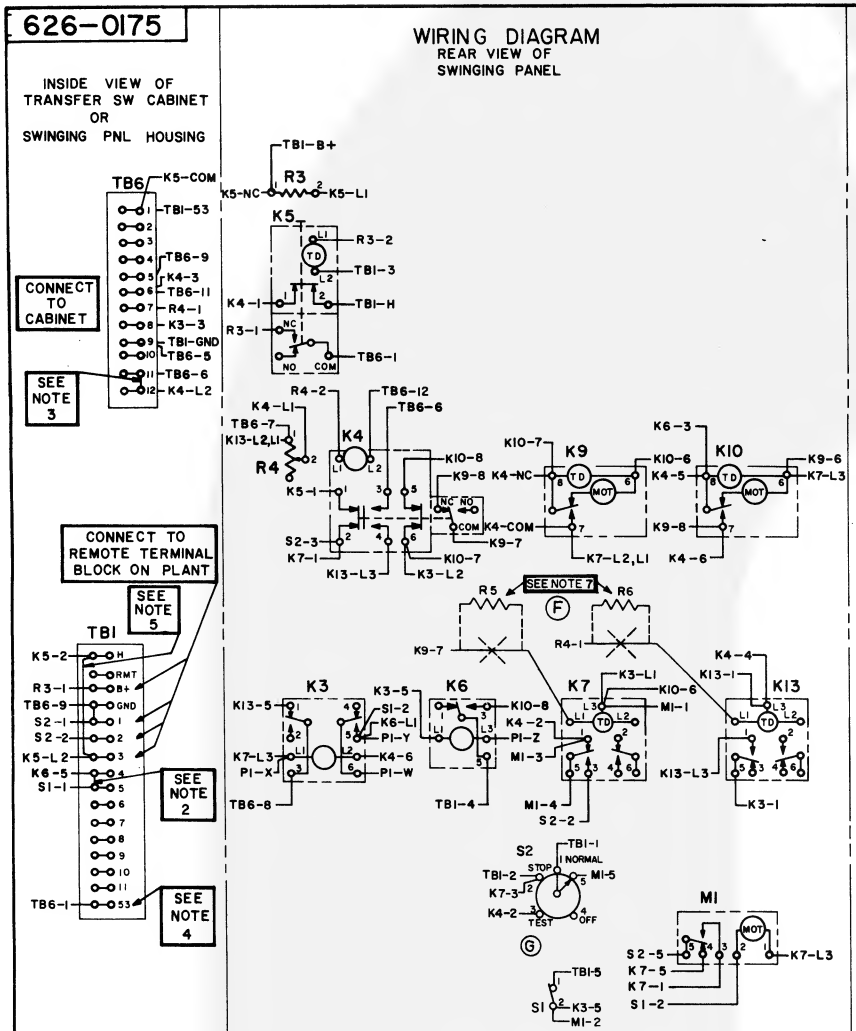
DRAWN 1-6-75 | DR. ADB | ENGR. Jim Wint | CKR. CDR

NAME CONTROL ACCESS. PANEL (WIRING DIAGRAM)

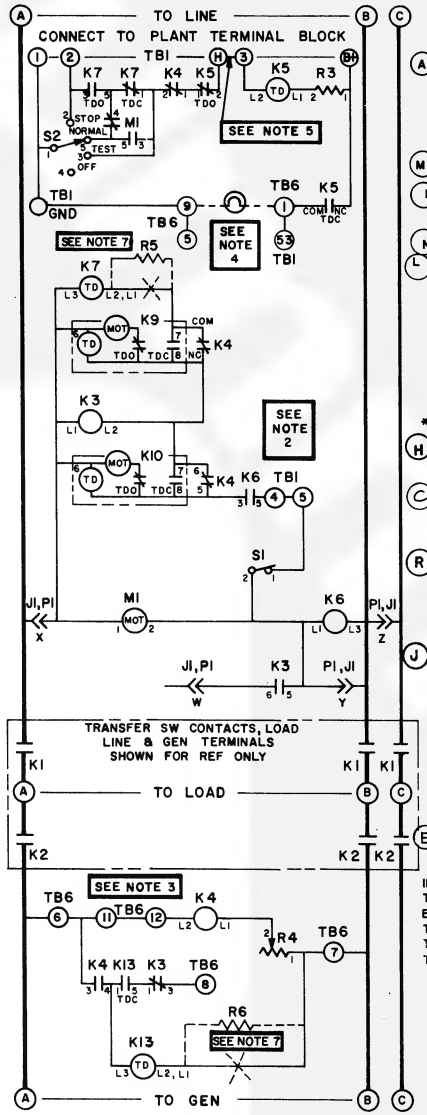
SEPIA FROM 626-0175 | DRG NO 626-0075 | SHT SIZE C

626-0175

WIRING DIAGRAM
REAR VIEW OF
SWINGING PANEL



SCHEMATIC



PARTS LIST					
REF. DES.	PART NO.	DWG SIZE	QTY	* BULK	DESCRIPTION
K3	307-1113	B	1		RELAY-INTERPOSING LINE (208V)
	307-1083	B	1		RELAY-INTERPOSING LINE (240V)
K4	307-0664	C	1		RELAY-INTERPOSING GEN
K5	320-0221	B	1		CRANKING LIMITER ASSY
K6	307-1114	B	1		RELAY-PHASE PROTECTION (208V)
	307-1081	B	1		RELAY-PHASE PROTECTION (240V)
K7	307-1158	B	1		RELAY-TIME DELAY ON STARTING
					1 TO 300 SEC ON DE-ENERGIZATION
	301-3315	A	1		MOUNTING PKG-RELAY PNL
K9	307-1419	B	1		RELAY ASSY-TIME DELAY ON STOPPING
					AFTER RETRANSFER (50/60Hz)
					2 TO 60 MIN ON ENERGIZATION
K10	307-0724	B	1		RELAY-TD ON RETRANSFER (50/60Hz)
	336-2309	A	1		LEAD ASSY
K13	307-1144	B	1		RELAY-TIME DELAY ON TRANSFER
					1 TO 300 SEC ON ENERGIZATION
	301-3315	A	1		MOUNTING PKG-RELAY PNL
	336-2310	A	1		LEAD ASSY
MI	307-1103	B	1		CLOCK-PLANT EXERCISER (60Hz)
	307-1105	B	1		CLOCK-PLANT EXERCISER (50Hz)
PI	323-0901	A	1		PLUG-LINE DISCONNECT
	301-3765	A	2		PLATE-PANEL INTERLOCK
	503-0801	—	1		HOSE
R3	353-0055	A	1		RESISTOR, 3 Ω, 10W
R4	304-0131	A	1		RESISTOR, 750 Ω, 25W
R5,6	304-0718	A	2		RESISTOR ASSY 500 Ω 25W (50 HZ, 240V
SI	308-0069	P	1		SWITCH-TEST TRANSFER
S2	308-0193	A	1		SWITCH-SELECTOR
	303-0076	—	1		KNOB
	336-9310	A	1		LEAD
TBI	332-1699	A	1		MARKER STRIP
TB6	332-1469	A	1		MARKER STRIP
	332-1969	A	1		CLAMP-CABLE (USE ON PI)
	503-0721	P	1		BUSHING-RUBBER (USE ON PI)
	301-3825	D	1		PANEL-SWINGING RELAY
	98-2795	D	1		SILKSCREEN-PANEL (FRONT)
	98-2796	D	1		SILKSCREEN-PANEL (REAR)
	405-1872	A	2		CLIP-DOOR
	526-0003	—	2		WASHER-FLAT
	818-0150	—	2		RIVET-DRIVE
	338-0921	E	1		WIRING HARNESS-MAIN
	301-2259	A	1		PLATE-COVER
	301-4087	B	2		PLATE-COVER (VOLT SENSOR)
	301-4141	B	1		PLATE-COVER (BAT CHARGER)

626-0175

CONTROL ACCESSORY GROUP 55 (B)

INCLUDES ALL STANDARD ITEMS, PLUS;
TD RETRANSFER 2-60 MIN
EXERCISER CLOCK
TD START 1-300 SEC
TD TRANSFER 1-300 SEC
TD STOP 2-60 MIN

-01	60Hz	240V
-02	50Hz	240V
-03	60Hz	208V
-04	50Hz	208V

LET	REVISION	CKR.	ENGR.	DATE
K	REM K9 307-1418	CDR	JM	4-21-78
J	ADDED 332-1969 & 503-0721	CDR	JM	3-24-76
H	WAS 503-0276, QTY 15"	CDR	JM	3-24-76
G	CHG LOCATION OF SI & S2	CDR	JM	3-31-76
F	UPDATED R5, R6	CDR	JM	3-29-76
E	ADDED 301-4087 & 301-4141	CDR	JM	3-29-76
D	CHG NOTE 7 FOR 50HZ	WB	JM	2-5-76
C	ADDED R5 & R6	WB	JM	2-5-76
B	GROUP NO. WAS 05	WB	JM	2-5-76
A	K6 WAS 307-0114	WB	JV	2-17-75

20418					
	R	ADDED 336-9310	CDR	JM	3-24-76
	P	ADDED OT E	CDR	VK	6-6-79
	N	KIO 307-0724 WAS (60 Hz)	CDR	KS	4-21-78
	M	K9 307-1419 WAS (60 Hz)	CDR	KS	4-21-78
ER	L	REM K10 307-0723	CDR	KS	4-21-78

MODEL NO. AT E OT E (P)

208/240V, 3 PH, 4W, ℄ 50/60 Hz

Ongn — DIVISION OF ONAN CORPORATION, Minneapolis, Minnesota

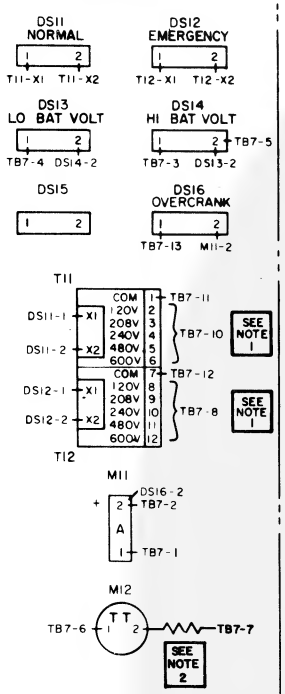
DATE 1-6-75 | DR. ADB | ENGR. JAM V.I.N.T. | CKR. CDR

NAME CONTROL ACCESS. PANEL (WIRING DIAGRAM)

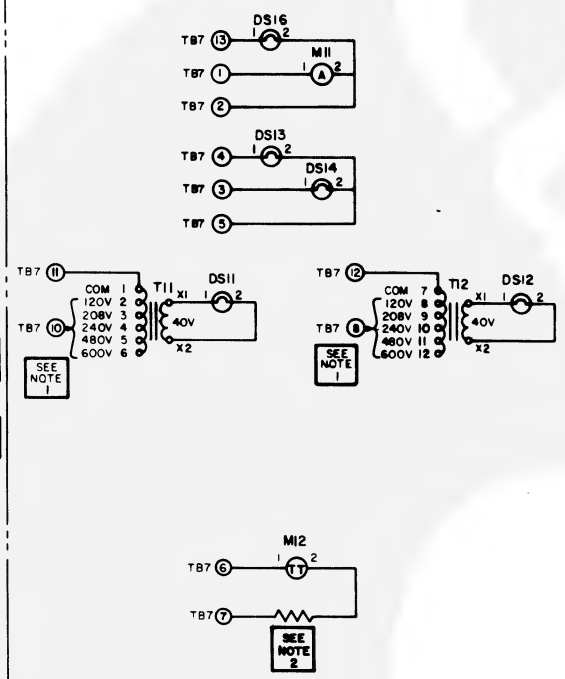
SEPIA FROM | DWG NO. 626-0175 | DWG SIZE C

626-0364 DWG SIZE C

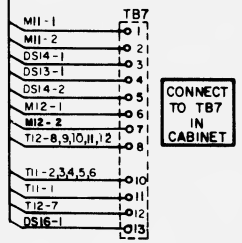
REAR VIEW OF METER PANEL



SCHEMATIC



LEFT SIDE OF CABINET



NOTE:
1. WIRE TRANSFORMER T11 & T12 AS FOLLOWS
   FOR 120V, CONNECT TB7-10 TO T11-2
   TB7-8 TO T12-8
   FOR 208V, CONNECT TB7-10 TO T11-3
   TB7-8 TO T12-9
   FOR 240V, CONNECT TB7-10 TO T11-4
   TB7-8 TO T12-10
   FOR 480V, CONNECT TB7-10 TO T11-5
   TB7-8 TO T12-11
   FOR 600V, CONNECT TB7-10 TO T11-6
   TB7-8 TO T12-12
2. USE RESISTOR WITH RUNNING TIME METER ON 600V, 60Hz ONLY

PARTS LIST

REF. DES.	PART NO	DWG SIZE	QTY	DESCRIPTION
DSII	322-0146	A	1	LAMP - NORMAL 56V
DSI2	322-0147	A	1	LAMP - EMERGENCY 56V
DSI3	322-0114	A	1	LAMP - LO BAT VOLT (14V) (OT D & E)
	322-0126	A	1	LAMP - LO BAT VOLT (28V) (OT C)
DSI4	322-0115	A	1	LAMP - HI BAT VOLT (14V) (OT D & E)
	322-0127	A	1	LAMP - HI BAT VOLT (28V) (OT C)
DSI5	322-0141	A	1	LENS & BEZEL ASSY
DSI6	322-0107	A	1	LAMP - OVERCRANK (14V)
MII	302-0807	A	1	AMMETER - BAT CHARGER 0-2 AMP
MI2	302-0465	P	1	METER - RUNNING TIME (120V) (600V) (60Hz)
	302-0486	P	1	METER - RUNNING TIME (240V) (60Hz)
	302-0467	P	1	METER - RUNNING TIME (480V) (60Hz)
	304-0636	A	1	RESISTOR, 9000Ω, 50W (600V) (60Hz) (USE WITH 302-0465 RTM ON 600V)
	302-0488	P	1	METER - RUNNING TIME (120V) (50Hz)
	302-0489	P	1	METER - RUNNING TIME (240V) (50Hz)
	302-0470	P	1	METER - RUNNING TIME (480V) (50Hz)
T11,12	315-0374	C	1	TRANSFORMER ASSY - STEPDOWN
	338-0883	C	1	HARNESS - METER
	338-0661	C	1	HARNESS - LAMPS (NORMAL & EMERGENCY)
	338-0659	B	1	HARNESS - LAMPS (BAT VOLTS)
	98-2445	A	1	LABEL - POWER SENTRY
	301-4308	C	1	PANEL - METER
	98-2413	D	1	SILKSCREEN - METER PANEL
	98-3102	D	1	SILKSCREEN - LAMP PANEL (FRONT)

626-0364

METER - LAMP COMBINATION 16

CHARGE AMMETER
OVERCRANK LAMP (USE ON OT E ONLY)
RUNNING TIME METER

NORMAL & EMERGENCY LAMPS
BATTERY VOLTAGE LAMPS

THIS INFORMATION IS FOR MANUFACTURERS USE ONLY

HERTZ	VOLTAGE	OT C	OT D&E
60	120V	-01	-08
60	208-240V	-02	-09
60	480V	-03	-10
60	600V	-04	-11
50	120V	-05	-12
50	208-240V	-06	-13
50	480V	-07	-14

PROD REL Jim Vint 9-3-76
PROD REL

LET	REVISION	CHK	ENGR	DATE
C	[illegible]			

DIVISION OF ONAN CORPORATION Minneapolis, Minnesota

MODEL: OT C, OT D, OT E } SPEC A

DATE 9-3-76 | DR | ENGR Jim Vint | CHK CDR

METER LAMP PANEL (WIRING DIAGRAM)

120,208,240,480,600V 1 & 3PH 50/60Hz

SEPIA FROM 626-0164 | DWG NO 626-0364 | REV C

Modifications

Modifications to the automatic transfer switches are described in this section. At the end of the section, instructions are also given for adding a module to the control accessory panel of groups 10 through 15 and 20 through 25. For calibration checks and adjustments of new modules or relays, etc., see the *ADJUSTMENTS section.*

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery, and remove AC power before attempting modifications.***

CHANGING THREE-PHASE TO SINGLE-PHASE

To change a three-phase OT to a single-phase OT, use the following procedure.

1. Open the cabinet door of the automatic transfer switch.
2. Move the operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control; or in cabinet for three-wire starting with OT-E control). Tag selector switch.
3. Disconnect the generator set starting batteries.
4. Remove AC power from the OT. Tag disconnect switch.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery, and remove AC power before attempting modifications.***

5. Remove the control disconnect plug and open the control accessory panel.
6. **100 through 280 ampere OT:** Remove the two screws which secure the meter-lamp panel to the cabinet and swing open the hinged meter-lamp panel.
7. Remove generator, line, and load connections from the transfer switch terminal C.
8. Connect single-phase generator, line, and load connections to respective terminals A and B. Make sure single-phase voltages match transfer switch voltage. If not, change linear actuator and capacitor (if applicable) using the correct modification package.

CAUTION ***Be sure the single-phase voltage matches the transfer switch voltage. Incorrect voltage might damage the transfer switch.***

9. **Control accessory groups 10-15 and 20-25:** For control panels with plug-in modules, remove undervoltage sensors 2 and 3, if equipped, and overvoltage sensors 14 and 15, if equipped. Insert 300-1675 bypass plug modules into the module openings.

If a different generator set is used with a different voltage starting system, see *Changing Control Accessory Panel DC System Voltage.*

10. If the meter-lamp panel is three-phase only, remove the panel as described under *Changing Meter-Lamp Panel.* If the meter-lamp panel is a single- or single- and three-phase panel, rewire the connections on transformers T11 and T12 (if equipped). See Figure 1.
    A. For 120 volts, reconnect lead from TB7-10 to T11-2, and reconnect lead from TB7-8 to T12-8.
    B. For 240 volts, reconnect lead from TB7-10 to T11-4, and reconnect lead from TB7-8 to T12-10.
11. **100 through 280 ampere OT:** Close the meter-lamp panel and secure the top and bottom with the two screws removed in Step 6.
12. Close the control accessory panel and reconnect the control panel disconnect plug.
13. Restore AC voltage to the OT.
14. Reconnect the generator set starting batteries.
15. Move the operation selector on the engine control panel to REMOTE for two-wire starting with OT-C or OT-D control, or move the operation selector switch in the OT-E cabinet to NORMAL for three-wire starting, whichever applies.
16. Close the cabinet door.

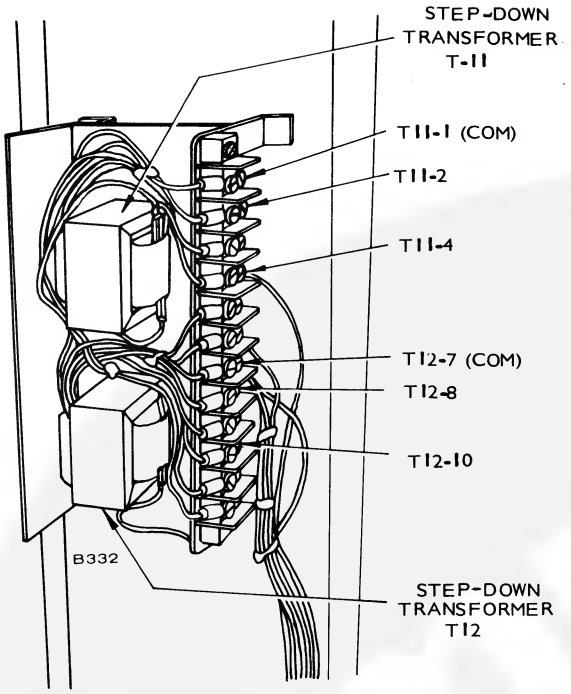


FIGURE 1. TRANSFORMERS T11 and T12 ON METER-LAMP PANEL

CHANGING METER-LAMP PANEL

To change a meter-lamp panel in an automatic transfer switch, use the following procedure.

1. Open the cabinet door of the automatic transfer switch.
2. Move the operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control; or in cabinet for three-wire starting with OT-E control). Tag selector switch.
3. Disconnect the generator set starting battery.
4. Remove AC power from the OT. Tag disconnect switch.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery, and remove AC power before attempting modifications.***

5. Remove the twist-lock disconnect plug and pull the control accessory panel open.

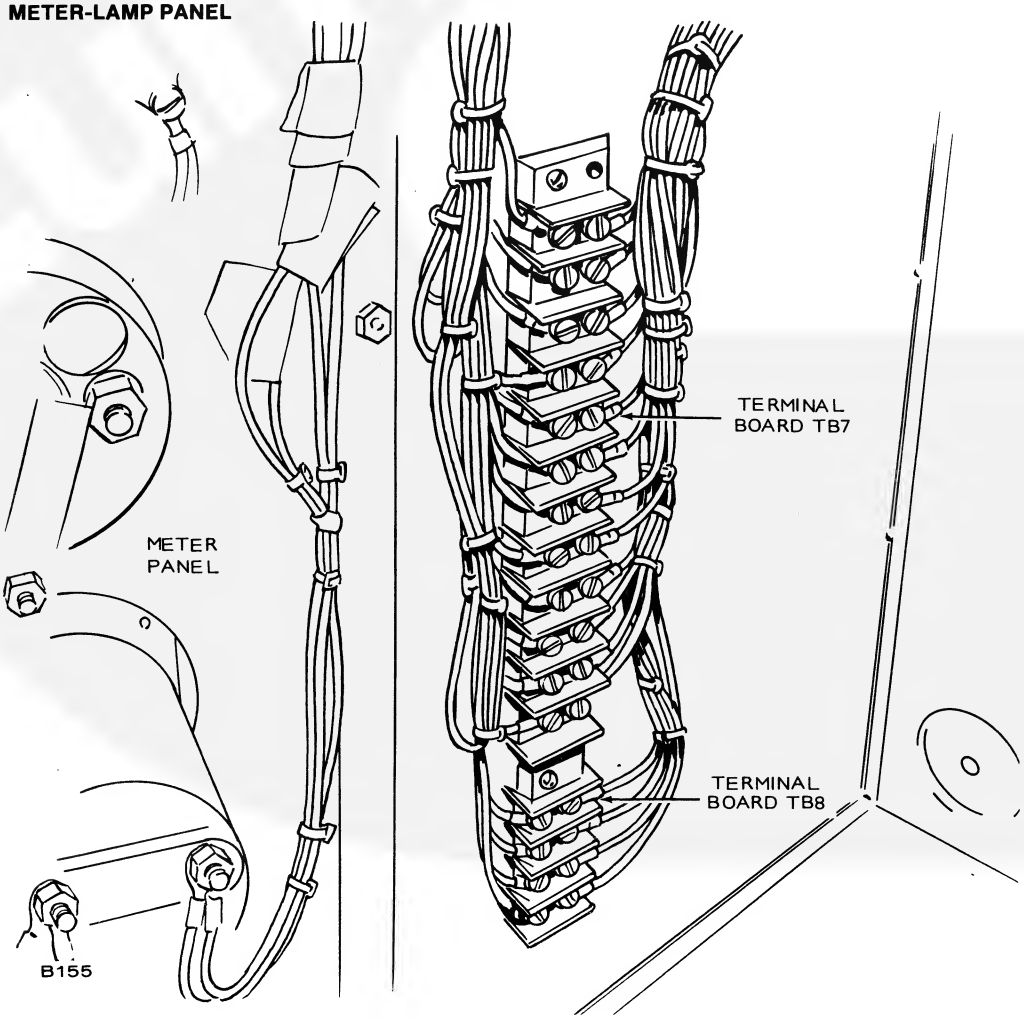


FIGURE 2. TERMINAL BOARD FOR METER—LAMP PANEL WIRE CONNECTIONS

6. **100 through 280 ampere OT:** Remove the two screws which secure the meter-lamp panel to the cabinet and open the meter-lamp panel.
7. Disconnect the meter-lamp panel wires from terminal blocks TB7 and TB8 (if present). See Figure 2.
8. **100 through 280 ampere OT:** Remove the four nuts and washers holding the meter-lamp panel on the left OT cabinet wall and remove panel.
9. **400 through 1000 ampere OT:** Remove the nuts and washers holding the meter-lamp panel to the left cabinet door and remove panel.
10. Mount the new meter-lamp panel using the same nuts and washers.
11. Connect the wire leads as marked from the meter-lamp panel wiring harness to terminal blocks TB7 and TB8 (if present).
12. **100 through 280 ampere OT:** Close the hinged meter-lamp panel and secure closed to the cabinet with the two screws removed in Step 6.
13. Close the control accessory panel and reconnect the twist-lock disconnect plug.
14. Restore AC voltage to the OT.
15. Move the operation selector switch on the engine control panel to REMOTE for two-wire starting with OT-C or OT-D, or move operation selector switch in the OT-E cabinet to NORMAL for three-wire starting, whichever applies.
16. Close the cabinet door.

CHANGING CONTROL ACCESSORY PANEL

Panel Groups 10-15 and 20-25

1. Open automatic transfer switch cabinet door.
2. Move operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control; or in cabinet for three-wire starting with OT-E control). Tag selector switch.
3. Remove AC voltage from the automatic transfer switch. Tag disconnect switch.
4. Disconnect the starting batteries.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery, and remove AC power before attempting modifications.***

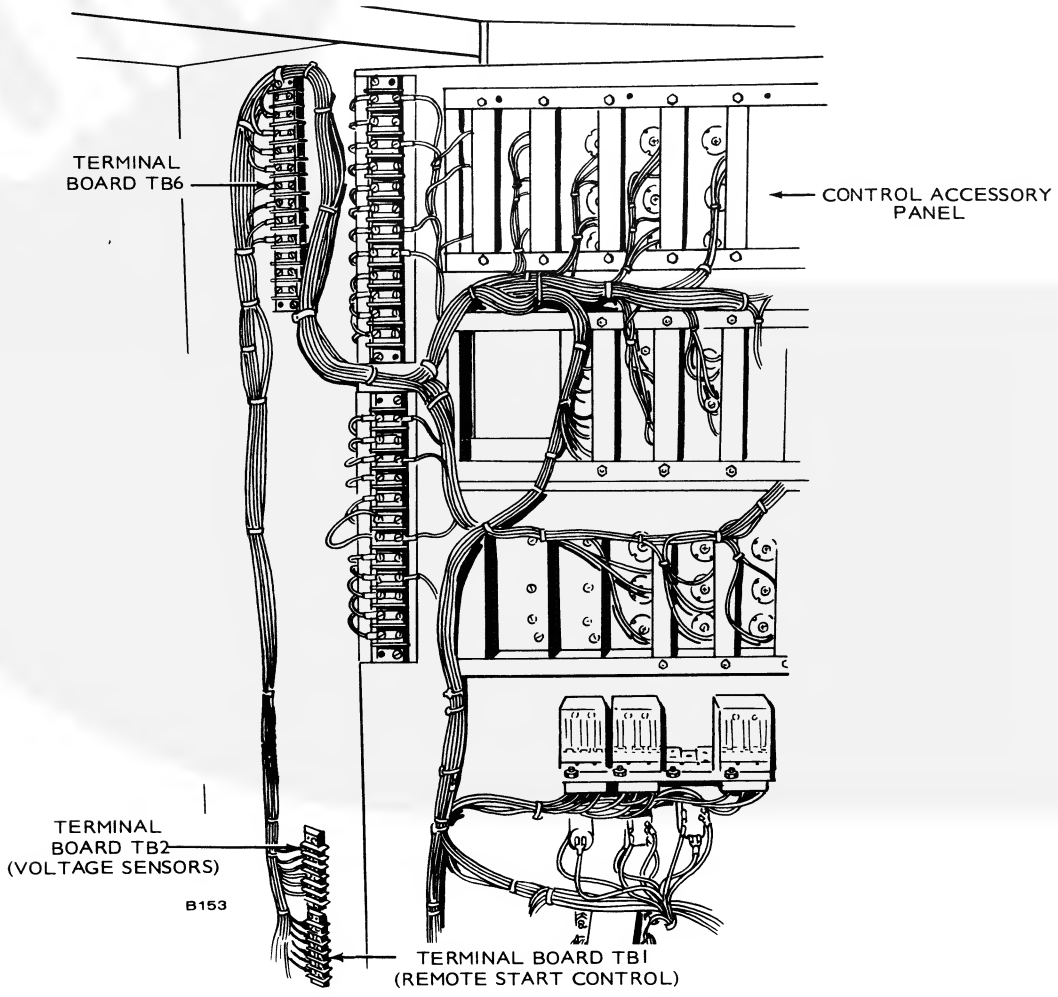


FIGURE 3. TERMINAL BOARD CONNECTIONS FOR CONTROL ACCESSORY PANEL

5. Remove the twist-lock disconnect plug and open the control accessory panel.
6. Remove external wires from TB1, TB2, and TB6 (if all present), then remove these terminal blocks from mounting. See Figure 3.
7. Hold the flange edge of the control accessory panel's bottom hinge pin with a needle-nose pliers (just above nylon spacer) and remove screw from pin with a screwdriver. The pliers prevent the pin from turning when loosening the screw (Figure 4).

WARNING ***When the screw is removed, the control accessory panel is loose on the bottom and could fall causing personal injury if not held. Have someone hold the panel during removal procedures to prevent personal injury.***

8. Carefully pull outward on bottom of control accessory panel until it clears cabinet.
9. Lower control accessory panel from cabinet. Top hinge pin will come out with control accessory panel.
10. Remove the top hinge pin from control accessory panel and install on new panel if required.
11. Lift up new control accessory panel into cabinet, carefully engaging top hinge pin.
12. Center the hole on the bottom control panel flange over the hinge pin.
13. Insert the screw in bottom hinge pin and tighten with screwdriver and pliers.
14. Install the terminal boards (from new control accessory panel) on the wall of the cabinet, using #6-32 screws. TB2 mounts just above TB1 remote terminal block, and TB6 in the upper right side.
15. Connect loose wire leads to terminal blocks as marked.
16. If an area protection circuit or remote test switch is used, remove the jumper between terminals TB1-4 and 5, and connect the wire leads from the equipment.
17. If the AC voltage of the new control accessory panel is different, see *Changing Control Accessory Panel AC Voltage.*
18. If the DC system voltage and number wire start is different on the new control panel, see *Changing Control Accessory Panel DC System Voltage* and/or *Three to Two Wire Start Conversion or Two to Three Wire Start Conversion (12 volts).*
19. For external alarms or signal circuits of the battery voltage sensors, connect lead wires to TB2. These contacts are rated 2 amperes for 12 volts DC or 120 volts AC.
20. Close the control accessory panel and reconnect the twist-lock disconnect plug.

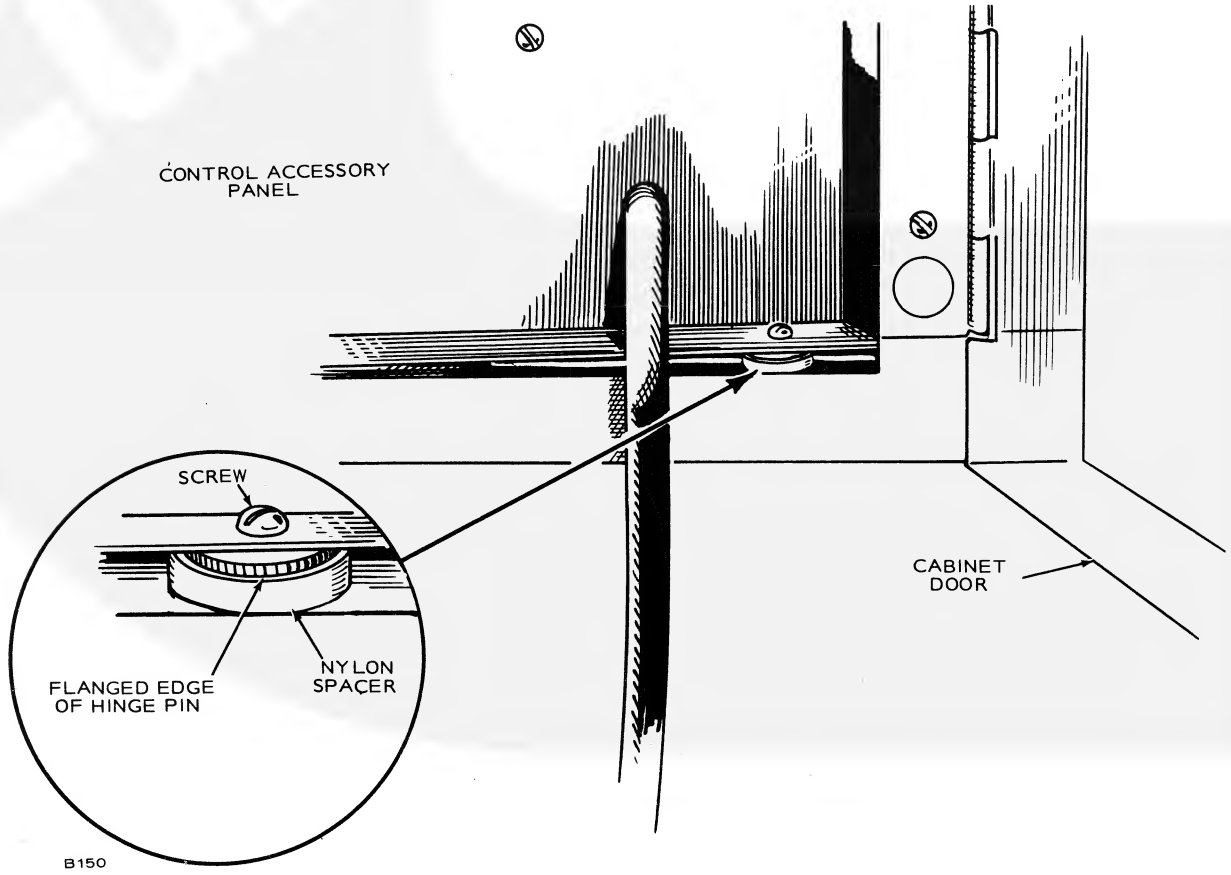


FIGURE 4. BOTTOM HINGE PIN FOR CONTROL ACCESSORY PANEL

21. Restore AC voltage to the automatic transfer switch.
22. Reconnect the starting batteries.
23. Move operation selector switch on the engine control to REMOTE for two-wire starting with OT-C or OT-D control, or move operation selector switch in the OT-E cabinet to NORMAL for three-wire starting, whichever applies.
24. Close the cabinet door.

Panel Groups 51 Through 55

The new control accessory panel installed must match AC system voltage and start control (2 or 3 wire) of panel removed.

1. Open automatic transfer switch cabinet door.
2. Move the operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control; or in cabinet for three-wire starting with OT-E control).
3. Disconnect the starting batteries.
4. Remove AC voltage from the automatic transfer switch.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery, and remove AC power before attempting modifications.***

5. Remove the twist-lock disconnect plug and open control accessory panel.
6. Remove the external wires from TB1 and TB6, then remove the terminal blocks from mounting. See Figure 3.
7. Hold the flange edge of the control accessory panel's bottom hinge pin with a needle-nose pliers (just above nylon spacer) and remove screw from pin with a screwdriver. The pliers prevent the pin from turning when loosening the screw (Figure 4).

WARNING ***When the screw is removed, the control accessory panel is loose on the bottom and could fall causing personal injury if not held. Have someone hold the panel during removal procedures to prevent personal injury.***

8. Carefully pull outward on bottom of control accessory panel until it clears cabinet.
9. Lower control accessory panel from cabinet. Top hinge pin will come out with control accessory panel.
10. Remove the top hinge pin from control panel and install on new panel if required.
11. Lift up new control panel into cabinet, carefully engaging top hinge pin.
12. Center the hole on the bottom control panel flange over the hinge pin.
13. Insert the screw in bottom hinge pin and tighten with screwdriver and pliers.
14. Install terminal boards TB1 and TB6 (from new control accessory panel). Connect loose wires in cabinet to terminal blocks as marked.
15. If an area protection circuit or a remote test switch is used, remove the jumper between terminals TB1-4 and -5, and connect the wire leads from the equipment.
16. Close the control accessory panel and reconnect the twist-lock disconnect plug.
17. Set the time delays following instructions in the *ADJUSTMENTS* section.
18. Restore AC voltage to the automatic transfer switch.
19. Reconnect the starting batteries.
20. Move the operation selector switch on engine control panel to REMOTE for two-wire starting with OT-C or OT-D, or move operation selector switch in the OT-E cabinet to NORMAL for three-wire starting, whichever applies.
21. Close the cabinet door.

CHANGING CONTROL ACCESSORY PANEL AC SYSTEM VOLTAGE

This modification applies only to control accessory panels in groups 10 through 15 and 20 through 25.

If the control accessory panel has been changed and its nominal voltage differs from the automatic transfer switch, use the following procedure:

1. Open automatic transfer switch cabinet door.
2. Move the operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control; or in cabinet for three-wire starting with OT-E control).
3. Disconnect the starting batteries.
4. Remove AC voltage from the automatic transfer switch.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery, and remove AC power before attempting modifications.***

5. Remove the twist-lock disconnect plug and control accessory panel.
6. Rewire the stepdown transformers T2, T3, T4, and T5 using the wiring diagram furnished with the control accessory panel. Change the wire lead connections on the right side (facing panel rear) of the terminal strip for the transformers. See Figure 5.

7. Rewire battery charger transformer T1 (if control panel has battery charger) so the wire from F1-2 and T1-H5 (COM) go to the appropriate connections on the transformer for the nominal AC voltage (Figure 6). See the wiring diagram for the correct connections.
8. Close the control accessory panel.
9. Reconnect the twist-lock disconnect plug.
10. Restore AC voltage to the automatic transfer switch.
11. Reconnect the starting batteries.
12. Move the operation selector switch on the engine control to REMOTE for two-wire starting, with OT-C or OT-D, or move operation selector switch in the OT-E cabinet to NORMAL for three-wire starting, whichever applies.

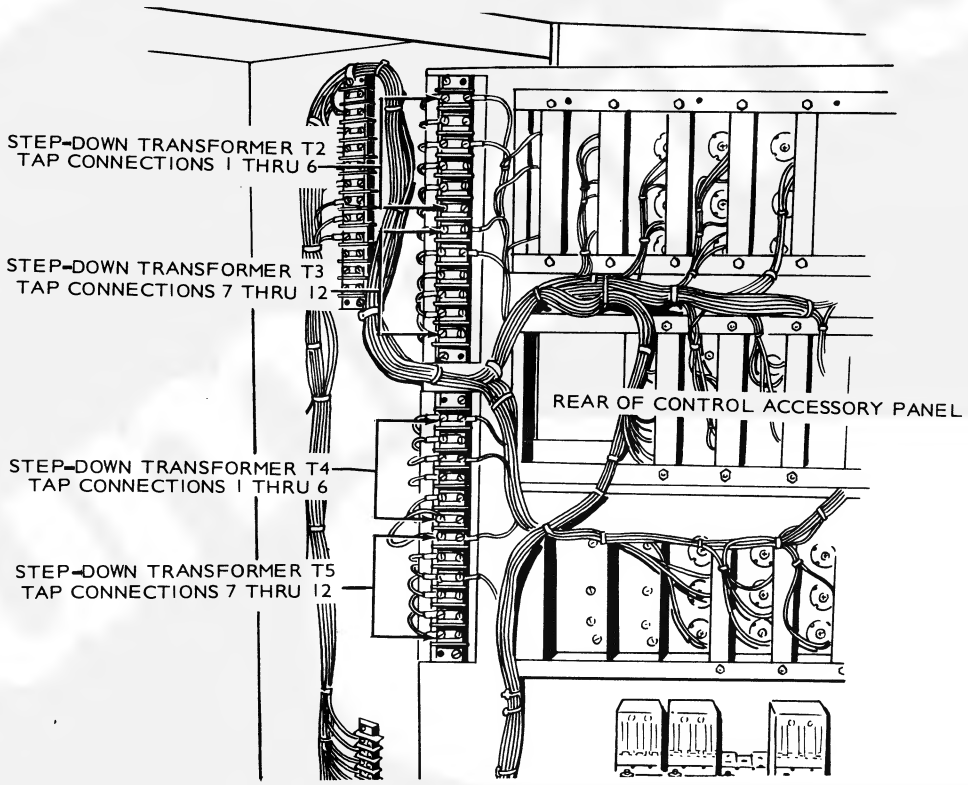


FIGURE 5. AC VOLTAGE CONNECTIONS FOR STEP-DOWN TRANSFORMERS

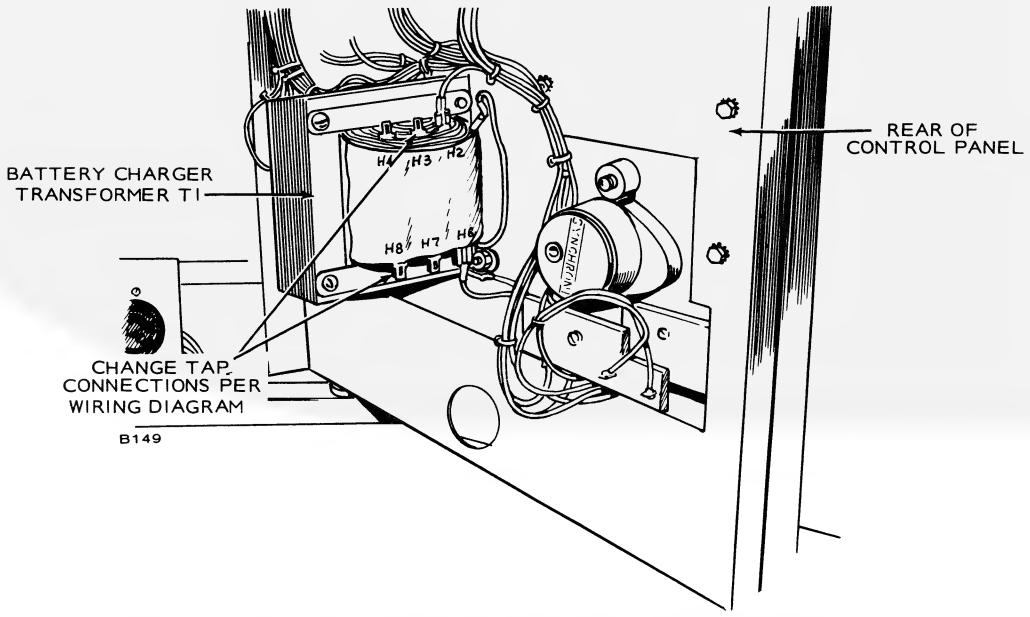


FIGURE 6. BATTERY CHARGER TRANSFORMER AC CONNECTIONS

13. Close the cabinet door.

CHANGING CONTROL ACCESSORY PANEL DC SYSTEM VOLTAGE

This modification applies only to control accessory panels in groups 10 through 15 and 20 through 25.

From 24 to 12 Volts

Some control accessory panels do not have all the items mentioned in the following procedures. For example, a group 10 panel does not have a battery charger module, battery transformer T1, charger resistor R1, high and low battery voltage indicator lamps DS14 and DS13, etc. If a panel does not have the mentioned item, proceed to the next step.

1. Open the automatic transfer switch cabinet door.
2. Move operation selector switch on engine control panel to STOP.
3. Disconnect the starting batteries.
4. Remove AC voltage from the automatic transfer switch. Tag disconnect switch.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery and remove AC power before attempting modifications.***

5. Remove the twist-lock disconnect plug and open the control accessory panel.
6. Remove the wire lead from transformer T1 terminal T1-X3 and connect to terminal T1-X2 (Figure 7).
7. Remove the wire lead from resistor R1 terminal R1-3 and connect to terminal R1-2. See Figure 8.
8. Remove the 24-volt battery charger module 6 (number 300-0794) and replace with the 12-volt module, number 300-0793.
9. Remove the 24- to 12-volt converter module 5 (number 300-0848) and replace with the 12-volt module, number 300-0847.
10. If module 10 is a 24-volt battery voltage sensor, number 300-0797, remove and replace it with a 12-volt, number 300-0796 sensor module.
11. **100 through 280 ampere OT:** Remove the one screw on top and one screw on bottom from inside the meter-lamp panel. Swing the meter-lamp panel outward.
12. Remove "LO BAT VOLT" lamp DS13 and "HI BAT VOLT" lamp DS14 from the meter-lamp panel and replace with 322-0114 and 322-0115 lamps respectively.
13. **100 through 280 ampere OT:** Close the meter-lamp panel and secure the top and bottom with the two screws.
14. Close the control accessory panel and reconnect the twist-lock disconnect plug.

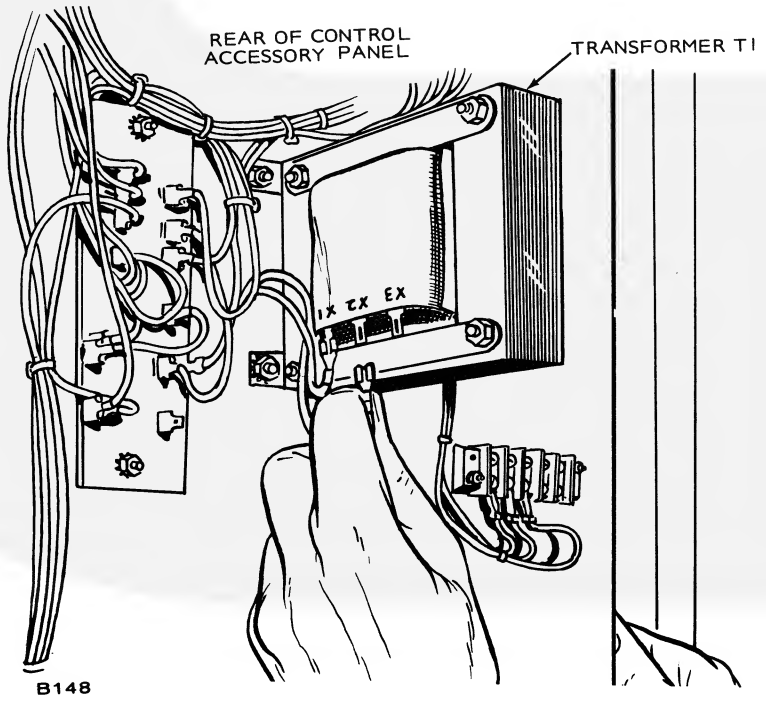


FIGURE 7. BATTERY CHARGER TRANSFORMER DC CONNECTIONS

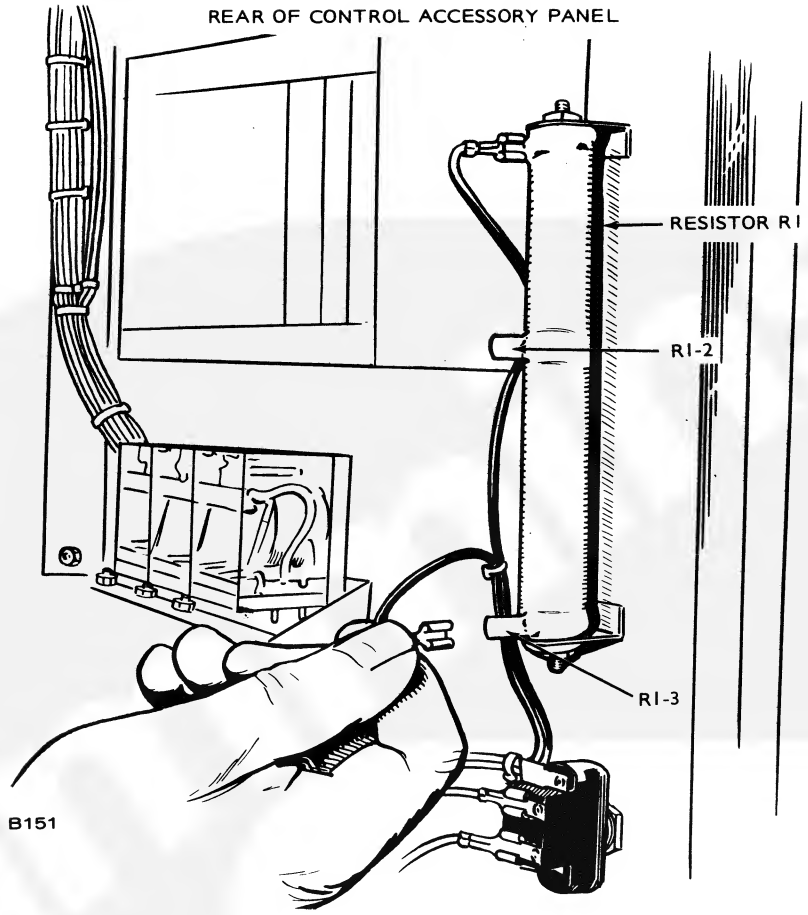


FIGURE 8. CHANGING RESISTOR R1 TAP SETTING

If starting is changed from two-to three-wire starting, proceed to that modification described in this section.

15. Connect a 12-volt battery and restore AC voltage to the automatic transfer switch.
16. Move the operation selector switch on the engine control to REMOTE for two-wire starting with OT-C or OT-D control, or move operation selector switch in the OT-E cabinet to NORMAL for three-wire starting, whichever applies.
17. Close the cabinet door.

From 12 to 24 Volts

Some control accessory panels do not have all the items mentioned in the following procedures. For example, a group 10 panel does not have a battery charger module, battery charger transformer T1, charger resistor R1, high and low battery voltage indicator lamps DS14 and DS13, etc. If a panel does not have the mentioned items, proceed to the next step.

1. Open the automatic transfer switch cabinet door.
2. Move operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control; or in cabinet for three-wire starting with OT-E control). Tag selector switch.
3. Disconnect the starting batteries.
4. Remove AC voltage from the automatic transfer switch. Tag disconnect switch.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery and remove AC power before attempting modifications.***

5. Remove the twist-lock disconnect plug and open the control accessory panel.
6. Remove the wire lead from transformer T1 terminal T1-X2 and connect to terminal T1-X3 (Figure 7).
7. Remove the wire lead from resistor R1 terminal R1-2 and connect to terminal R1-3. See Figure 8.
8. Remove the 12-volt battery charger module 6 (number 300-0793) and replace with the 24-volt module, number 300-0794.
9. Remove the 12-volt module 5 (number 300-0847) and replace with the 24- to 12-volt converter module, number 300-0848.
10. If module 9 is a 2 to 3 wire converter, number 300-0926, remove and replace with a blank (spare) 300-0937 module.
11. If module 10 is a 12-volt battery voltage sensor, number 300-0796, remove and replace it with a 24-volt, number 300-0797 sensor module.

12. **100 through 280 ampere OT:** Remove the one screw on top and one screw on bottom from inside meter-lamp panel. Swing hinged panel outward.
13. Remove "LO BAT VOLT" lamp DS13 and "HI BAT VOLT" lamp DS14 from the meter-lamp panel and replace with 322-0126 and 322-0127 lamps respectively.
14. **100 through 280 ampere OT:** Close the meter-lamp panel and secure the top and bottom with the two screws.
15. Close the control accessory panel and reconnect the twist-lock disconnect plug.

If starting is changed from three to two-wire starting, proceed to that modification in this section.

16. Connect a 24-volt battery and restore AC voltage to the automatic transfer switch.
17. Move the operation selector switch on the engine control to REMOTE for two-wire starting with OT-C and OT-D control or move operation selector switch in the OT-E control to NORMAL for three-wire starting, whichever applies.
18. Close the cabinet door.

TWO TO THREE WIRE START CONVERSION (12 VOLTS)

This procedure applies only to control accessory panels in groups 10 through 15 and 20 through 25.

To convert a two-wire start control automatic transfer switch to three-wire start, use the following procedure:

1. Move the operation selector switch on the engine control to STOP. Tag selector switch.
2. Disconnect the starting batteries.
3. Remove AC voltage from the automatic transfer switch. Tag disconnect switch.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery, and remove AC power before attempting modifications.***

4. Open the automatic transfer switch cabinet door.
5. Remove the remote start wire leads between the engine control remote terminal block and the automatic transfer switch terminal block TB1.
6. Remove the 300-0937 blank (spare) module 9 and replace with a 300-0926 2 to 3 wire converter module.
7. Check battery voltage (battery must be a 12-volt unit). If DC system was 24 volts, make the conversion *Changing Control Accessory Panel DC System Voltage* described in this section.
8. Connect automatic transfer switch to terminals TB1-B+, -1, and -3 to the three-wire start engine control.
9. Restore AC voltage to the automatic transfer switch.
10. Connect the starting batteries.
11. Move the operation selector switch on the 2 to 3 wire converter module 9 to NORMAL.
12. Close the cabinet door.

THREE TO TWO WIRE START CONVERSION

This procedure applies only to control accessory panels in groups 10 through 15 and 20 through 25.

For a conversion from a three-wire, 12-volt system to a two-wire, 12-volt system, proceed to Step 1. For a conversion to a two-wire, 24-volt crank system however, change the DC system voltage as described in the procedure *Changing Control Accessory Panel DC System Voltage.* Then proceed to the following:

1. Open the automatic transfer switch cabinet door.
2. Move the operation selector switch on 2 to 3 wire converter module 9 to STOP. Tag selector switch.
3. Disconnect the starting batteries.
4. Remove AC voltage from the automatic transfer switch. Tag disconnect switch.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery, and remove AC power before attempting modifications.***

5. Remove the wire leads between the engine control remote terminal block and the automatic transfer switch remote terminal block TB1.
6. Remove 300-0926 2 to 3 wire converter module 9 and replace it with a 300-0937 blank (spare) module.
7. Connect automatic transfer switch terminals TB1-B+, -RMT and -GND to the 2-wire start engine control.
8. Restore AC voltage to the automatic transfer switch.
9. Connect the starting batteries.

10. Move the operation selector switch on the engine control to REMOTE.
11. Close the cabinet door.

ADDING MODULE TO CONTROL ACCESSORY PANEL

The following procedure applies only to control accessory groups 10 through 15 and 20 through 25.

Whenever adding a plug-in module to the control accessory panel where there previously was a blank (spare), be sure to use the following procedure:

1. Open the cabinet door.
2. Move operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control; or in cabinet for three-wire starting with OT-E control) and disconnect starting battery. Tag selector switch.
3. Remove AC voltage from the automatic transfer switch. Tag disconnect switch.

WARNING ***The automatic transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to move the operation selector switch to STOP, disconnect the starting battery, and remove AC power before attempting modifications.***

4. Remove the twist-lock disconnect plug and open control accessory panel.
5. Install keying plug(s), #332-2114 for begin Spec B or #332-1276 for Spec A OT, in the slot(s) of the printed circuit board receptacle as needed. Figure 9 shows how a keying plug is inserted into the receptacle. See a control accessory panel wiring diagram which shows location of the keying plug(s) for that particular module.
6. Insert the new module in the control accessory panel.
7. Restore AC voltage to the automatic transfer switch.
8. Close the control accessory panel and reconnect the disconnect plug.
9. Move the operation selector switch on the engine control to REMOTE for two-wire starting with OT-C or OT-D control, or move operation selector switch in OT-E cabinet to NORMAL for three-wire starting, whichever applies.
10. Close the cabinet door.

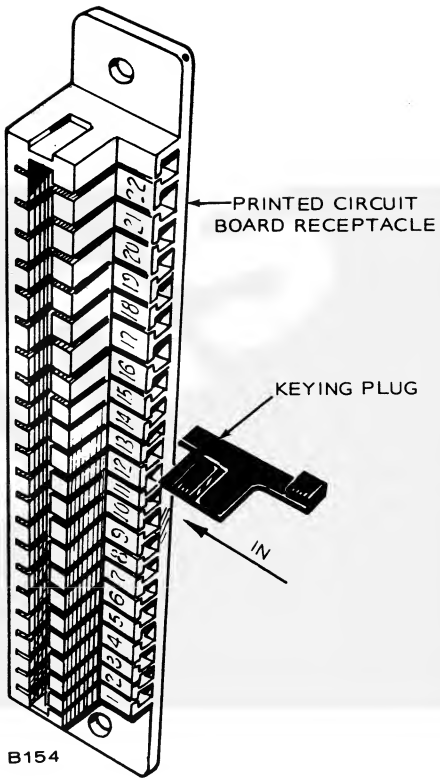


FIGURE 9. INSTALLATION OF KEYING PLUG

Adjustments

LATCH AND LATCH PIN ADJUSTMENT

If the control accessory panel will not close because the latch is above or below the latch pin, perform the following:

1. Open cabinet door of automatic transfer switch.
2. Disconnect the generator set starting battery(ies) if applicable. Shut down set first if running.
3. Remove AC voltage from the automatic transfer switch. Tag disconnect switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to disconnect the starting battery if applicable and remove AC power before attempting adjustments.***

4. Remove the twist-lock disconnect plug.
5. Completely open the control accessory panel.
6. **100 through 280 ampere OT:** Remove the one screw on top and one screw on bottom from inside meter panel flange. Open meter panel.
7. Loosen the latch pin and move the latch pin up or down in the slot as necessary (Figure 10). Then tighten.
8. **100 through 280 ampere OT:** Close the meter panel and reinstall the two screws removed in Step 6.
9. Close the control accessory panel. If more adjustment is necessary, repeat Steps 5 through 8.
10. Reconnect the twist-lock disconnect plug.
11. Restore AC voltage to the automatic transfer switch.
12. Close the cabinet door.
13. Reconnect starting battery(ies) if applicable.

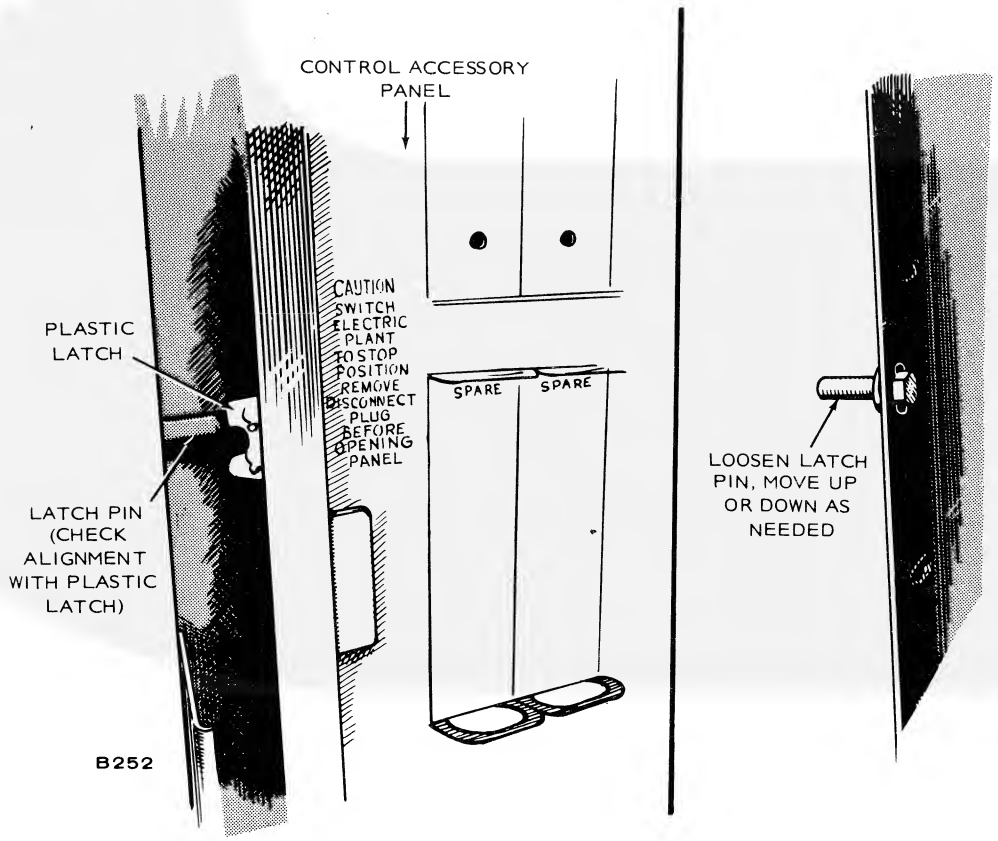
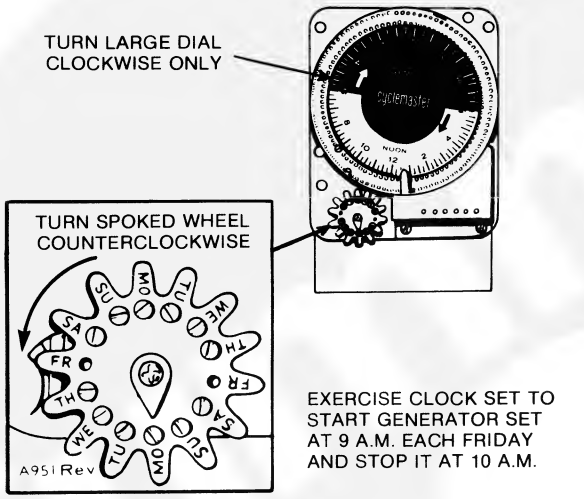


FIGURE 10. ADJUSTMENT OF LATCH PIN

EXERCISER CLOCK

1. Open the cabinet door of the automatic transfer switch.
2. Move the operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control, or in cabinet for three-wire starting with OT-E control).
3. Install a trip pin *(left-hand thread)* in the inside row of holes on the large dial for the time of day you want the generator set to start. See Figure 11.



NOTE: Trip pins are left-hand thread.

FIGURE 11. EXERCISER CLOCK SC-1385

4. Place a trip pin *(left-hand thread)* in the outside row of holes on the large dial to stop the generator set.

Onan recommends settings which operate the generator set for at least 30 minutes each week. Exercising for one long period is better than several short periods.

5. Install a trip pin *(left-hand thread)* in the small spoked wheel for every day *no exercise* is desired.
6. Rotate the large dial *clockwise* until the correct time is correctly aligned with the time pointer.
7. Turn the small spoked wheel *counterclockwise* until the correct day aligns with the pointer.

Sixteen trip pins are supplied with the clock. Store unused pins on the time pointer bracket.

8. Move the operation selector switch on the engine control panel to REMOTE for two-wire starting with OT-C or OT-D control, or move operation selector switch in OT-E cabinet for NORMAL for three-wire starting, whichever applies.
9. Close the cabinet door.

TIME SWITCH ADJUSTMENT

If you want to change the change-over interval durations for the generator sets of a generator set-to-generator set OT, use the following steps. Onan recommends shutting down both generator sets during the procedure.

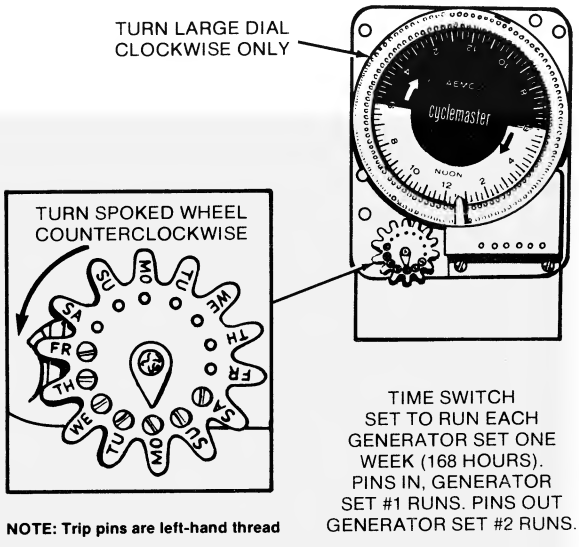
1. Open the cabinet door of the automatic transfer switch.
2. Move the operation selector switches to STOP, located in OT cabinet for three-wire starting or on generator set control panels for two-wire starting, and disconnect starting batteries.
3. Install a trip pin *(left-hand thread)* in the small spoked wheel for the days you want Generator Set #1 to operate (pins out, Generator Set #2 will operate).

   A. For 168-hour (7-day) operation of one generator set and then 168-hour operation of the other generator set, install 7 trip pins in consecutive positions in the small spoked wheel. See Figure 12.

   B. For 24-hour (1-day) operation of one generator set and then 24-hour operation of the other generator set, install a trip pin in every alternate day in the small spoked wheel.

Store unused pins in the time pointer bracket.

4. Rotate the large dial *clockwise* until the correct time is aligned with the time pointer.



NOTE: Trip pins are left-hand thread

FIGURE 12. TIME SWITCH SETTINGS SC-1093

5. Turn the small spoked wheel *counterclockwise* until the correct day aligns with the pointer.
6. Connect the starting batteries, and move the operation selector switches to REMOTE for two-wire starting or to NORMAL for three-wire starting (one generator set should start and assume load).
7. Close the cabinet door.

AC VOLTAGE SENSORS

Voltage sensors can be used for either undervoltage or overvoltage sensing on normal side, or undervoltage sensing on emergency side. Range of the settings is from 90 to 140 volts for a nominal 120-volt system. For higher voltage systems, the pick-up voltage knob readings are multiplied by the following multiplying factors.

VOLTAGE	MULTIPLYING FACTOR
120	1.0
208	1.73
240	2.0
480	4.0
600	5.0

If you wish to check the calibration of the sensors before making the settings, see the following. Otherwise, see *Undervoltage Sensor Settings* or *Overvoltage Sensor Settings.* Refer to Figure 13.

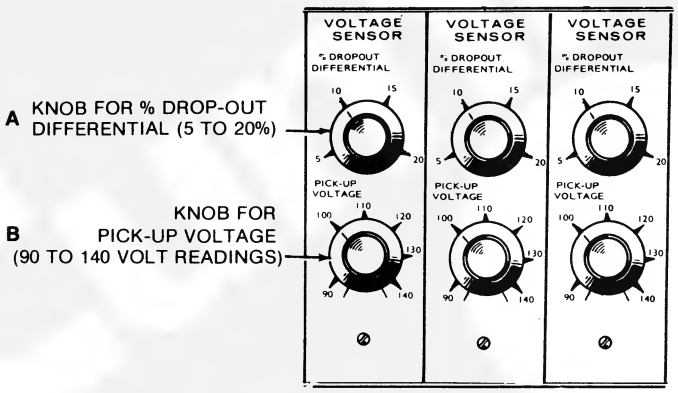


FIGURE 13. VOLTAGE SENSORS

For a generator set-to-generator set model OT (prime power model) or an OT with a relay group 51 through 55 control panel, proceed to the settings procedure.

Throughout the following procedures, the text will refer to the % DROP-OUT DIFFERENTIAL knob as knob A and to the PICK-UP VOLTAGE knob as knob B (see Figure 13).

Undervoltage Sensor Calibration

1. Open the cabinet door of the automatic transfer switch.
2. Move the operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control, or in cabinet for three-wire starting with OT-E control). For a utility-to-utility model OT, move the transfer inhibit switch in the cabinet to TEST.
3. Turn all the undervoltage snesor knobs to minimum voltage setting.
4. Turn knob B of the sensor to be calibrated to its clockwise limit.
5. Turn knob B very slowly counterclockwise until you hear relay K3 pick up. This reading times the multiplying factor (for your system voltage) should equal the line voltage. Check the source voltage with a voltmeter, divide by the factor to see if the reading is correct. If it is, proceed to Step 7. If not, proceed to Step 6.

6. *Setting Too Low:*

   A. Turn knob B to its clockwise limit, then counterclockwise to desired setting.

   B. Insert a small screwdriver through the CALIBRATE hole and turn counterclockwise very slowly until you hear relay K3 pick up.

   Setting Too High:

   A. Turn knob B to its clockwise limit.

   B. Insert a small screwdriver through the CALIBRATE hole and turn to its clockwise limit.

   C. Turn knob B to desired setting.

   D. Turn the CALIBRATE adjustment counterclockwise very slowly until you hear relay K3 pick up.

7. Repeat Steps 3 through 6 for each undervoltage sensor. If these calibrations are satisfactory for your application, make the sensor settings. See *Undervoltage Sensor Settings* (near end of section).
8. For a more accurate calibration and calibration of the % DROP-OUT DIFFERENTIAL knob A, use the Onan Multi-Tester or a variac and use the following procedure.
9. Remove the twist-lock disconnect plug and open the control accessory panel.
10. On the back side and top left of the control accessory panel, remove the white plastic cover which covers the transformer terminals for T2 and T3 (Figure 14).

    In order to check voltage sensor calibrations, you must vary the input voltage to the respective transformer. The following procedure isolates transformer T2 from the normal line connection of the control and connects it to an independent power source.

11. Remove the transformer leads from T2-1 (COM) and T2-2 (120-V) from left side of the terminal strip and connect them to the output leads of a 120-volt variac (240-volt variac would require removal of transformer leads from T2-1 and T2-4 and connecting variac to these leads, etc.). See Figure 15. (Use instructions with Onan Multi-Tester if used.)
12. Note right side of terminal strip to see which terminal of T2-2 through T2-6 has an AC input lead. For example, a wire connected to T2-3 indicates 208 volts AC input. On the left side of the terminal strip, remove the corresponding transformer lead and tape it. Figure 15 shows an example of this.

    If this transformer lead is already removed and connected to variac or Onan Multi-Tester because its nominal voltage matches transformer input voltage, ignore this step.

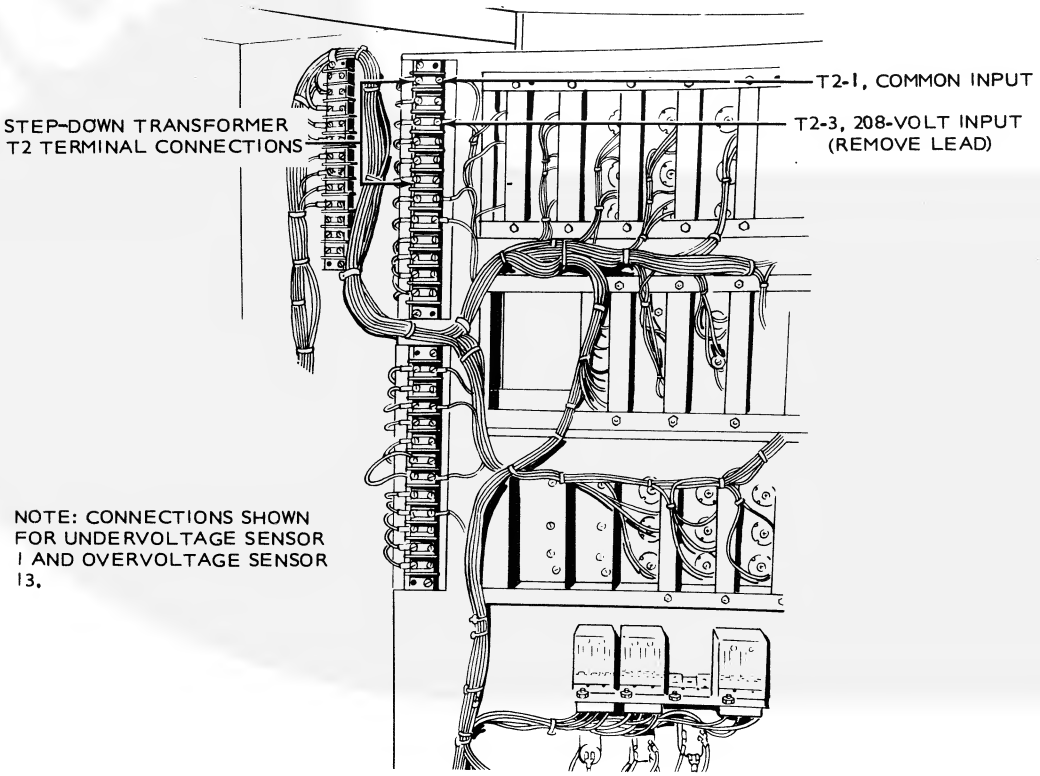


FIGURE 14. VOLTAGE SENSOR TRASNFORMER CONNECTIONS

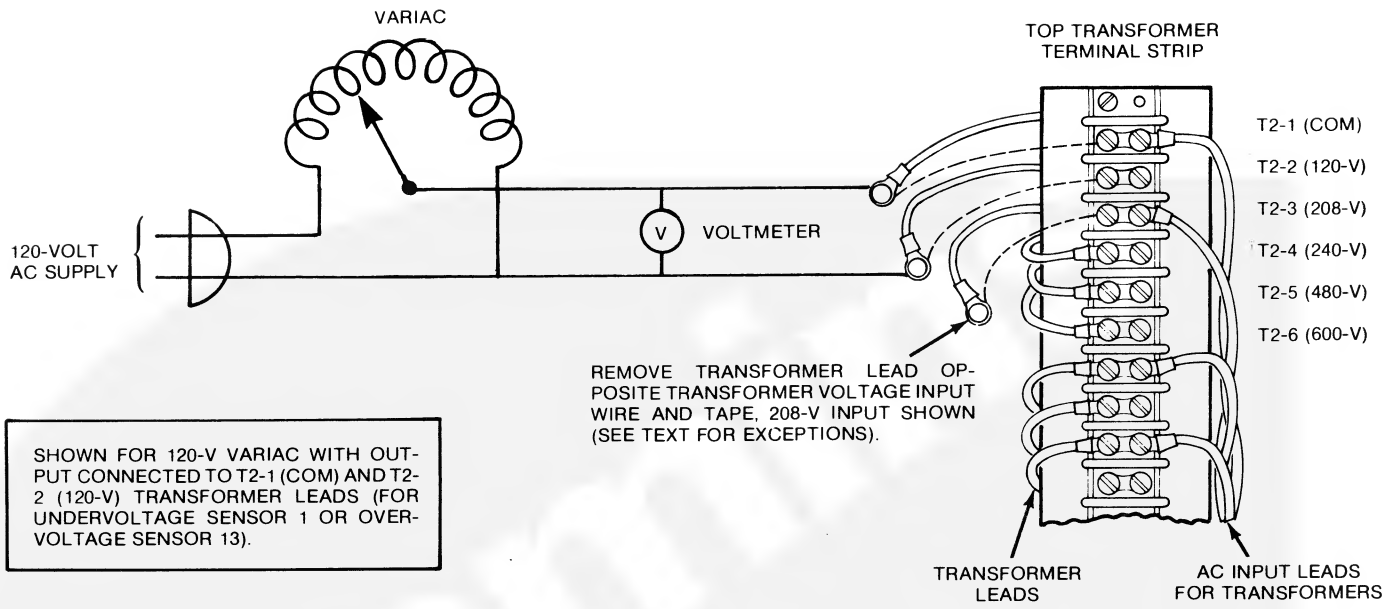


FIGURE 15. CONNECTION OF VARIAC TO TRANSFORMER

13. Connect a voltmeter to the output leads of the variac.
14. Connect the variac to a 120-volt AC source.
15. Reconnect the disconnect plug.

WARNING ***High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!***

16. Turn all the undervoltage sensor knobs to minimum.
17. Adjust the variac or Multi-Tester to give a 120-volt output for undervoltage sensor module 1 in module position 1.
18. Turn knob B on voltage sensor 1 to its clockwise limit.
19. Turn the knob very slowly counterclockwise until you hear relay K3 pick up. The knob should indicate 120 volts. If not, proceed to Step 20. If it does read 120 volts, proceed to Step 21.
20. *Setting Two Low:*

    A. Turn knob B to its clockwise limit, then counterclockwise to desired setting.
    B. Insert a small screwdriver through the CALIBRATE hole and turn counterclockwise very slowly until you hear relay K3 pick up.

    Setting Too High:

    A. Turn knob B to its clockwise limit.
    B. Insert a small screwdriver through the CALIBRATE hole and turn to its clockwise limit.
    C. Turn knob B to desired setting.
    D. Turn the CALIBRATE adjustment counterclockwise very slowly until you hear relay K3 pick up.

21. With sensor module knob B at 120 volts and knob A at maximum, lower the AC output voltage from the Multi-Tester or variac until the voltmeter reads 108 volts.
22. Turn knob A counterclockwise until you hear relay K3 drop out. The knob should read approximately 10 (90 percent of 120 volts = 108 volts). If not, use a small screwdriver to loosen the knob and reposition so it indicates 10 percent.
23. Set knobs A and B at desired settings.
24. Decrease the voltage with the Multi-Tester or variac until you hear relay K3 drop out.
25. Increase the voltage with the Multi-Tester or variac until you hear relay K3 pick up.
26. Readjust knobs A and B to give the desired pick-up and drop-out voltages.
27. Rather than reconnecting the voltmeter, variac or Multi-Tester for the other undervoltage sensors, pull out the already calibrated module and replace it with one of the other undervoltage sensors. Then perform the calibration procedures in this position.
28. After calibration is complete, remove the disconnect plug.
29. Disconnect the Multi-Tester or Variac and voltmeter.
30. Reconnect the wire leads and install the plastic cover over the terminals.
31. Close the control accessory panel and reconnect and disconnect plug.
32. Make the sensor settings. See *Undervoltage Sensor Settings* (near end of section).

Overvoltage Sensor Calibration

1. Open the cabinet door of the automatic transfer switch.
2. Move the operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control, or in cabinet for three-wire starting with OT-E control). For a utility-to-utility model OT, move the transfer inhibit switch to TEST.
3. Turn all the % DROP-OUT DIFFERENTIAL A knobs of the overvoltage sensors to minimum and all the PICK-UP VOLTAGE B knobs to the clockwise limit (maximum).
4. On the sensor to be calibrated, turn knob B very slowly counterclockwise until you hear relay K6 close. This reading times the multiplying factor should equal the line voltage. Check the source voltage with a voltmeter, divide by the factor to see if the reading is correct. If it is, proceed to Step 6. Otherwise, proceed to Step 5.
5. *Setting Too Low:*

   A. Turn knob A counterclockwise to minimum.
   B. Turn knob B to the desired setting.
   C. Insert a small screwdriver through the CALIBRATE hole and turn counterclockwise very slowly until you hear relay K6 pick up.

   Setting Too High:

   A. Turn knob B to its clockwise limit.
   B. Insert a small screwdriver through the CALIBRATE hole and turn to its clockwise limit.
   C. Turn knob B to the desired setting.
   D. Turn the CALIBRATE adjustment counterclockwise very slowly until you hear relay K6 pick up.

6. Repeat Steps 3 through 5 for each overvoltage sensor. If these calibrations are satisfactory for your application, make the sensor settings. See *Overvoltage Sensor Settings* (near end of section).
7. For a more accurate calibration and calibration of knob A, use the Onan Multi-Tester or a variac and use the following procedure.
8. Remove the twist-lock disconnect plug and open the control accessory panel.
9. On the back side and top left of the control accessory panel, remove the white plastic cover which covers the transformer terminals for T2 and T3 (Figure 14).

   In order to check voltage sensor calibrations, you must vary the input voltage to the respective transformer. The following procedure isolates transformer T2 from the normal line connection of the control and connects it to an independent power source.

10. Remove the transformer leads from T2-1 (COM) and T2-2 (120-V) from left side of the terminal strip and connect them to the output leads of a 120-volt variac (240-volt variac would require removal of transformer leads from T2-1 and T2-4 and connecting variac to these leads. etc.) See Figure 15. (Use instructions with Onan Multi-Tester if used.)
11. Note right side of terminal strip to see which terminal of T2-2 through T2-6 has an AC input lead. For example, a wire connected to T2-3 indicates 208 volts AC input. On the left side of the terminal strip, remove the corresponding transformer lead and tape it. Figure 15 shows an example of this.

    If this transformer lead is already removed and connected to variac or Onan Multi-Tester because its nominal voltage matches transformer input voltage, ignore this step.

12. Connect a voltmeter to the output leads of the variac.
13. Connect the variac to a 120-volt AC source.
14. Reconnect the disconnect plug.

    WARNING ***High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!***

15. Turn knob(s) A to minimum and knob(s) B to the clockwise limit (maximum).
16. Adjust the Multi-Tester or variac to give a 120-volt output for the overvoltage sensor module.
17. Turn knob B on the sensor to be calibrated counterclockwise very slowly until you hear relay K6 close. The knob should indicate 120 volts. If not, proceed to Step 18. If it does, proceed to Step 19.
18. *Setting Too Low:*

    A. Turn knob A counterclockwise to minimum.
    B. Turn knob B to the desired setting.
    C. Insert a small screwdriver through the CALIBRATE hole and turn counterclockwise very slowly until you hear relay K6 pick up.

    Setting Too High:

    A. Turn knob B to its clockwise limit.
    B. Insert a small screwdriver through the CALIBRATE hole and turn to its clockwise limit.
    C. Turn knob B to the desired setting.
    D. Turn the CALIBRATE adjustment counterclockwise very slowly until you hear relay K6 pick up.

19. Turn the sensor module knob B to 132 volts, relay K6 should drop out. Increase the AC output voltage from the Multi-Tester or variac until relay K6 picks up at approximately 132 volts.
20. Decrease the Multi-Tester or variac output voltage to check % DROP-OUT DIFFERENTIAL. With the knob set at 5 percent, relay K6 should drop out at approximately 95 percent of 132 volts = 125 to 126 volts. If not, use a small screwdriver to loosen the knob and reposition so it indicates 5 percent with drop-out voltage of 125 to 126 volts.

21. Set A and B knobs at desired settings.
22. Increase the voltage with the Multi-Tester or variac until you hear relay K6 pick up.
23. Decrease the voltage with the Multi-Tester or variac until you hear relay K6 drop out.
24. Readjust A and B knobs to give the desired pickup and drop-out voltages.
25. Rather than reconnecting the voltmeter, variac or Multi-Tester for the other overvoltage sensors (if more than one), pull out the already calibrated module and replace it with one of the other overvoltages sensors. Then perform the calibration procedures in this position.
26. After calibration is complete, remove the disconnect plug.
27. Disconnect the Multi-Tester or variac and voltmeter.
28. Reconnect the wire leads and install the plastic cover over the terminals.
29. Close the control accessory panel and reconnect the disconnect plug.
30. Make the sensor settings. See *Overvoltage Sensor Settings (*following).

Undervoltage Sensor Settings

Use the following steps for setting undervoltage sensors. Your settings, however might vary considerably from the example shown due to your particular application requirements. Use settings which give load protection and yet will avoid "nuisance" load transfers.

1. Open the cabinet door.
2. For an OT with a generator set system, disconnect the starting batteries (only of the idle generator set for a generator set-to-generator set prime power system). For a utility-to-utility OT model, move the transfer inhibit switch to TEST.
3. Turn the PICK-UP VOLTAGE knob to the desired pick-up voltage, voltage at which load is picked up by the power source which is sensed. A setting of 108 volts, for example, gives a pick-up voltage which is 90 percent of the nominal voltage for a 120-volt system.
4. Turn the % DROP-OUT DIFFERENTIAL knob to the desired percent deviation below the pick-up voltage. This setting determines the voltage at which load is transferred from the sensed power source to the other power source. A setting of 15 percent, for example, would give a 16-volt differential from 108 volts (pick-up voltage from Step 3). Drop-out voltage is then pick-up voltage minus the differential voltage, 108 - 16 = 92 volts.
5. After settings are finished, reconnect the starting batteries if applicable. For a utility-to-utility model OT, move the transfer inhibit switch to NORMAL.
6. Close the cabinet door.

Overvoltage Sensor Settings

Use the following steps for setting overvoltage sensors. Your settings, however, might vary considerably from the example shown due to your particular application requirements. Use settings which give load protection and yet will avoid "nuisance" load transfers.

1. Open the cabinet door.
2. For an OT with a generator set system, disconnect the starting batteries (only of the idle generator set for a generator set-to-generator set prime power system). For a utility-to-utility OT model, move the transfer inhibit switch to TEST.
3. Turn the PICK-UP VOLTAGE knob to the desired pick-up voltage, voltage at which load is transferred from the sensed power source to the other power source. A setting of 135 volts, for example, gives a pick-up voltage which is 113 percent of the nominal voltage for a 120-volt system.
4. Turn the % DROP-OUT DIFFERENTIAL knob to the desired percent deviation below the pick-up voltage. This setting determines the voltage at which load is transferred from the other power source fo the sensed power source. A setting of 5 percent, for example, would give a 7-volt differential from 135 volts (pick-up voltage from Step 3). Drop-out voltage is then 135-7 = 128 volts.
5. After settings are finished, reconnect the starting batteries if applicable. For a utility-to-utility model OT, move the transfer inhibit switch back to NORMAL.
6. Close the cabinet door.

BATTERY FLOAT CHARGE

For the following adjustments, a fully-charged battery, a hydrometer and an accurate voltmeter (1/2 percent accuracy) are needed. Onan recommends float voltages of: 13.3 volts for nominal 12-volt or 26.6 volts for nominal 24-volt lead-acid batteries; 14.0 to 14.5 volts for 10-cell nickel-cadmium batteries, or 28.0 to 29.0 volts for 20-cell nickel-cadmium batteries.

Lead-acid battery only: during the first few weeks of operation, the batteries should be checked periodically with the hydrometer. A high specific gravity, bubbling of electrolyte and loss of water indicate excessive float voltage. A drop in specific gravity indicates insufficient float voltage.

1. Connect the fully-charged battery. Verify charge condition with the hydrometer.
2. Connect the voltmeter directly to the battery terminals..
3. Measure the battery voltage. If voltage is above the recommended float voltage, proceed to Step 4. If the voltage is below the recommended float voltage, proceed to Step 7.

4. Open right cabinet door of automatic transfer switch.
5. Insert a small screwdriver through the hole in the front panel of battery charger module 6. Turn counterclockwise in small increments to decrease the float voltage.
6. After five minutes, measure the battery terminal voltage again. If voltage is still high, repeat Steps 5 and 6 until voltage stabilizes at the recommended float voltage. Proceed to Step 11.
7. Open right cabinet door of automatic transfer switch.
8. Note charge current rate on charge ammeter on meter-lamp panel.
9. Insert a small screwdriver through hole in front panel of battery charger module 6. Turn clockwise in small increments to increase float voltage. Note increase in the charging current on the charge ammeter on the meter-lamp panel.
10. In approximately one hour or when charge current has decreased to initial value notes in Step 8, recheck battery terminal voltage. Repeat Steps 8 through 10 until the battery terminal voltages stabilizes at the recommended float voltage.
11. Check the battery terminal voltage periodically during the first few weeks of operation. Readjust the float charge rate if necessary.
12. Close the cabinet door.

BATTERY VOLTAGE SENSOR ALARM SETTINGS

The following adjustments apply only to control accessory panel groups 10 through 15 and 20 through 25.

The high and low battery voltage alarm circuits monitor the condition of the battery charging system. A battery charging malfunction lights one of the lamps to indicate either a failure to charge ("LO BAT VOLTS") or battery overcharge ("HI BAT VOLT").

Ensuring proper function of both alarm lamps requires careful setting of the potentiometers for both the low and high battery voltage sensing circuits. Setting the alarm points requires a screwdriver, DC voltmeter (1/2 percent accuracy preferred), and a battery charger (separate charger required for high battery voltage alarm settings).

You can build a test fixture as shown in the *TROUBLESHOOTING* section for making adjustments on the battery voltage sensor module rather than using the following procedures.

High Battery Voltage Alarm Setting

1. Open cabinet door of automatic transfer switch.
2. Connect a DC voltmeter to the battery terminals.
3. Pull out the battery charger module 6.
4. Connect a separate battery charger to the battery.

Using a separate battery charger eliminates changing charger settings of battery charger module 6 for this procedure. The separate battery charger must have sufficient capacity for the particular battery.

5. For the alarm setting, the battery should be charged until the voltage reaches approximately:
   14.5 volts for a 12-volt lead-acid battery,
   29.0 volts for a 24-volt lead-acid battery,
   15.5 volts for a 10-cell nickel-cadmium battery, or
   31.0 volts for a 20-cell nickel-cadmium battery.

   Since these are suggested high battery settings, consult the battery manufacturer for the recommended alarm settings.
6. Insert a small screwdriver into the HIGH opening of battery voltage sensor module 10 for adjusting potentiometer R9. Adjust to the on-off point for the "HI BAT VOLT" lamp. The lamp must stay lit at this voltage.
7. Unplug or turn off the battery charger. The lamp must go out as soon as voltage drops a few tenths.
8. Turn on battery charger. The lamp must light as voltage returns to value given in Step 5.

   High battery voltage lamp does not light for normal operation.
9. Disconnect the battery charger and voltmeter.
10. Insert battery charger module 6 into control panel.
11. Close cabinet door.

Low Battery Voltage Alarm Setting

1. Open the cabinet door of the automatic transfer switch.
2. Connect a DC voltmeter to the battery terminals.
3. For the alarm setting, the battery should be charged until the voltage reaches approximately:
   12.9 to 13.3 volts for the 12-volt lead-acid battery,
   25.8 to 26.6 volts for the 24-volt lead-acid battery,
   13.8 to 14.5 volts for the 10-cell nickel-cadmium battery, or
   27.6 to 29.0 volts for the 20-cell nickel-cadmium battery.
4. Insert a small screwdriver into the LOW opening of battery voltage sensor module 10 for adjusting potentiometer R17. Adjust to the on-off point for the "LO BAT VOLT" lamp. The lamp must stay off.
5. Pull out the battery charger module 6. The lamp must light when the battery terminal voltage drops to:
   12.6 volts for the 12-volt battery,
   25.2 volts for the 24-volt battery,
   12.6 volts for the 10-cell nickel-cadmium battery, or
   25.2 volts for the 20-cell nickel-cadmium battery.
6. Insert battery charger module 6 back into its normal position. The "LO BAT VOLT" lamp must go out as the terminal voltage returns to values listed in Step 3.

7. Disconnect the voltmeter from the battery terminals.
8. Close the cabinet door.

OVERCRANK TIME (OT-E ONLY)

The following adjustment applies only to control accessory groups 10 through 15, 17, and 20 through 25.

Overcrank settings are made at the factory for approximately 75± 10 seconds cranking. To adjust, perform the following.

1. Remove the positive lead from the generator set's start solenoid or starter.
2. Open cabinet door of automatic transfer switch.
3. Move selector switch to WITHOUT LOAD.
4. Move 2 to 3 wire converter module 9 selector switch to NORMAL.
5. Move test transfer switch to TEST. Overcrank lamp on automatic transfer switch should light at end of crank period. Measure the crank time with a stop water or watch with a second hand.
6. To change the time, insert a small screwdriver through the CRANK TIME hole in the front of the 2 to 3 wire converter module. Turn clockwise to increase the cranking time or counterclockwise to decrease the cranking time. Make adjustments in small increments.
7. Move test transfer switch to NORMAL.
8. Push the PUSH TO RESET button on the 2 to 3 wire converter module.
9. Repeat Steps 5 through 8 until the desired cranking time is obtained.
10. Move selector switch switch to desired position, WITHOUT LOAD or WITH LOAD.
11. Close the cabinet door.
12. Reconnect positive lead to generator set's starter or start solenoid.

PROGRAMMED TRANSITION

To change the time delay setting of the programmed transition time delay, use the following procedure.

1. Open cabinet door of automatic transfer switch.
2. Disconnect the generator set starting battery(ies) if applicable.
3. For a utility-to-utility model OT, move the transfer inhibit switch to TEST.
4. Remove AC power to the automatic transfer switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious injury or death unless all AC power is removed. Be sure to disconnect starting battery (if applicable) and remove AC power before attempting adjustments.***

5. Remove the twist-lock disconnect plug and open the control accessory panel.
6. Locate the time delay (shown in Figure 16) in the rear of the cabinet on the transfer switch base assembly.
7. Turn the knob clockwise to increase delay (increments marked on knob), counterclockwise to decrease time delay.
8. Close the control accessory panel and reconnect the twist-lock disconnect plug.
9. Restore AC power to the automatic transfer switch.
10. For a utility-to-utility model OT, move the transfer inhibit switch back to NORMAL.
11. Reconnect the generator set starting battery(ies) if applicable.
12. Close the cabinet door.

FIGURE 16. PROGRAMMED TRANSITION TIME DELAY

TIME DELAYS OF CONTROL ACCESSORY GROUPS 10-15 AND 20-25

START-STOP TIME DELAY

If times for start or stop are desired other than presently set, use the following procedure:

1. Open the cabinet door of automatic transfer switch.
2. Move selector switch to WITH LOAD if equipped.
3. Move test transfer switch to TEST.
4. With a stopwatch or watch with a second hand, measure the time until the generator set starts cranking.
5. Insert a small screwdriver through START opening in front of start-stop time delay module 7. Turn START potentiometer clockwise to increase start time delay or counterclockwise to decrease start time delay. Make adjustments in small increments.
6. Move test transfer switch to NORMAL.
7. Measure time until generator set begins to shut down.
8. Turn STOP potentiometer with the small screwdriver clockwise to increase the stop time delay or counterclockwise to decrease the stop time delay. Make adjustments in small increments.
9. Repeat Steps 2 through 8 until desired delay times are obtained.
10. Move selector switch to desired position, WITHOUT LOAD or WITH LOAD if equipped.
11. Close the cabinet door.

TABLE 1. PROGRAMMABLE TIME DELAY

PROGRAMMABLE START — STOP TIMER

c = SWITCH CLOSED
o = SWITCH OPEN

SWITCH POSITIONS				
1	2	3	4	TO START
5	6	7	8	TO STOP
				TIME
o	o	c	o	0.5 sec
o	o	o	c	1.0 sec
c	o	c	o	1.4 sec
c	c	c	o	2.4 sec
c	o	o	c	5.5 sec
o	o	o	o	7.9 sec
c	c	o	c	9.6 sec
c	o	o	o	43 sec
o	o	c	c	62 sec
c	c	o	o	76 sec
c	o	c	c	345 sec
c	c	c	c	615 sec

TIME TOL ± 20%

OPTIONAL START-STOP TIME DELAY (BEGIN SPEC B)

For a time delay change of the programmable timer, pull out the time delay module 7 from the control panel and change the switch settings on the side of the printed circuit board for the desired times. Table 1 lists the switch positions for the available time delays. Figure 17 shows the module as viewed from the switch (right) side.

Example: For a start time delay of 2.4 seconds, close switches 1,2, and 3, and open switch 4. For a 345-second time delay on stopping, close switches 5, 7 and 8, and open switch 6.

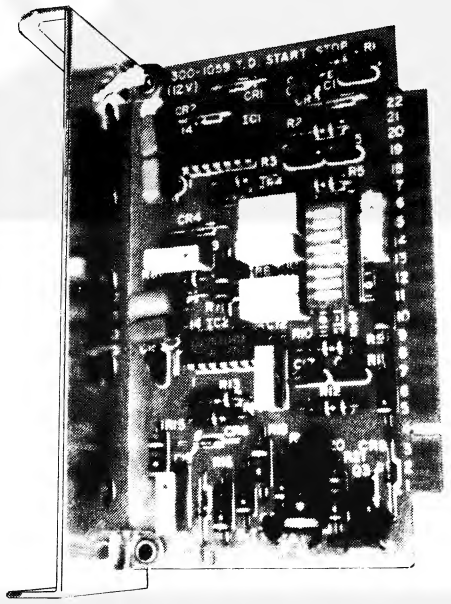


FIGURE 17. START-STOP TIME DELAY (BEGIN SPEC B)

TRANSFER-RETRANSFER TIME DELAY

To change the delay time of transfer-retransfer time delay module 8, use the following procedure and refer to Figure 18.

1. Open the cabinet door of the automatic transfer switch.
2. Move the selector switch if equipped to WITH LOAD.
3. Move the test transfer switch to TEST (generator set will start if applicable). With a stopwatch or watch with a second hand, measure the time the red transfer light-emitting diode (LED) on the transfer-retransfer time delay module 8 remains lit. The red LED will turn off after the time delay is complete. IF the time delay is correct or time you desire, proceed to Step 5. If not, proceed to Step 4.

4. Insert a small screwdriver through the TRANSFER opening (upper opening) in the front panel of the transfer-retransfer time delay module. Turn clockwise in small increments to increase the time delay, counterclockwise to decrease time delay.
5. Move the test transfer switch to NORMAL.
6. With a stopwatch or watch with a seconds hand, counter the number of flashes the bottom green LED makes in 60 seconds (Onan suggests counting for 60 seconds—shorter intervals would give less accuracy for determining time delays). Once retransfer timing is complete, the red retransfer LED will turn off and the green LED will remain on for the duration of the generator set stop delay, if applicable. The following list gives the correlating pulses to time delays.

Pulses/60 sec	Time Delay (min)
36	5
18	10
12	15
9	20
7	25
6	30

If time delay is correct or time you want, proceed to Step 9. Otherwise, proceed to Step 7.

7. Insert a small screwdriver through the RE-TRANSFER opening (lower opening) in the front panel of the transfer-retransfer time delay module. Turn clockwise in small increments to increase the time delay, counterclockwise to decrease the time delay.
8. Repeat Steps 3 through 7 until the desired time delays are obtained.
9. Move the selector switch if applicable to WITH LOAD if you want the generator set to assume load during exercise or tests.
10. Close the cabinet door.

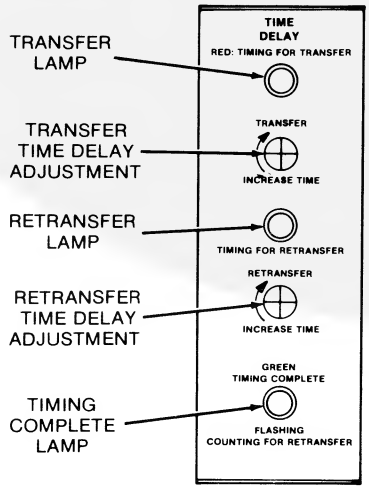


FIGURE 18. TRANSFER-RETRANSFER TIME DELAY

TRANSFER TIME DELAY (SPEC A ONLY)

For adjustment or change of the transfer time delay (transfer of the load to the generator set) from the standard setting, two to three seconds, use the following procedure:

1. Open right cabinet door of automatic transfer switch.
2. Move operation selector switch to STOP, on engine control for two-wire starting with OT-C or OT-D, or in OT-E cabinet for three-wire starting. Tag selector switch.
3. Move selector switch to WITH LOAD.
4. Remove the twist-lock disconnect plug.
5. Open the control accessory panel.
6. Locate generator interposing relay K4 on the rear side of the control accessory panel.
7. Reconnect the twist-lock disconnect plug with the control accessory panel open.

WARNING ***High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!***

8. Move operation selector switch to REMOTE (two wire starting) or NORMAL (three-wire starting), whichever applies.
9. Move test transfer switch to TEST. Generator set will start and run.
10. With a stopwatch or watch with a second hand, measure time from instant generator set reaches full speed until relay K4 contacts close. If time delay is correct or time you desire, proceed to Step 14. If not, proceed to Step 11.
11. Insert a small screwdriver through hole in front panel of transfer time delay module 8. Turn clockwise in small increments to increase the time delay, counterclockwise to decrease the time delay.
12. Move the test transfer switch to NORMAL to stop the generator set.
13. Repeat Steps 9 through 12 until the desired time delay is obtained.
14. Move the test transfer switch to NORMAL.
15. Move operation selector switch to STOP.
16. Remove the disconnect plug and close the control accessory panel.
17. Reconnect the disconnect plug.
18. Move the operation selector switch on the engine control to REMOTE for two-wire starting with OT-C or OT-D control, or more the operation selector switch in the OT-E cabinet to NORMAL for three-wire starting, whichever applies.
19. Return selector switch to desired position, WITHOUT LOAD or WITH LOAD.
20. Close the cabinet door.

RETRANSFER TIME DELAY (SPEC A ONLY)

The retransfer time delay can be used to provide 0 to 30 minutes, 36 minutes for 50 hertz, time delay on retransfer (retransfer of load to commercial power line). Shown in Figure 19 is the retransfer time delay with the "POWER ON" lamp and time adjustment knob. The adjustment knob has a black pointer and a red time-remaining indicator pointer. Turn the adjustment knob clockwise until the black pointer aligns with the desired time delay.

PREHEAT TIME DELAY (OT-E ONLY)

The preheat time delay module for diesel generator sets with 3-wire starting is adjustable from 5 to 60 seconds. To change the delay, follow these instructions:

1. Open the cabinet door of the automatic transfer switch.
2. Move the selector switch if equipped to WITHOUT LOAD.
3. Move the test transfer switch to TEST.
4. With a stopwatch or watch with a second hand, measure the amount of time the small lamp on preheat time delay module lights before engine cranks.
5. Move the test transfer switch back to NORMAL.
6. If time delay for preheat is set as desired, proceed to Step 9. If a different time is desired, proceed to Step 7.
7. Insert a small screwdriver through the PREHEAT opening in the front panel of preheat time delay module. Turn potentiometer clockwise to increase preheat time, counterclockwise to decrease delay. Make adjustments in small increments.
8. Repeat Steps 3 through 7 until desired preheat time is obtained.
9. Move selector switch if equipped to desired position, WITHOUT LOAD or WITH LOAD.
10. Close cabinet door of automatic transfer switch.

FIGURE 19. RETRANSFER TIME DELAY

TIME DELAYS OF CONTROL ACCESSORY GROUPS 51 THROUGH 55

START, TRANSFER, AND PREHEAT TIME DELAYS

Onan has suggested settings of 1 to 3 seconds for the start time delay, 2 to 5 seconds for the transfer time delay, and 60 seconds for the preheat time delay. All require the same adjustments for changing settings and have time ranges of 1 to 300 seconds. To make the settings, perform the following.

1. Open the cabinet door of the automatic transfer switch.
2. Turn the knob on the time delay clockwise to increase delay time, counterclockwise to decrease the delay time. See Figure 20.
3. Close the cabinet door.

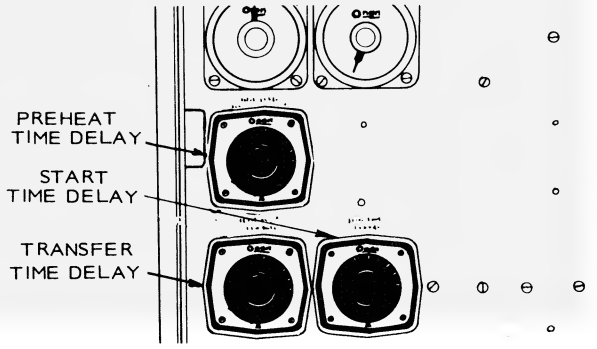


FIGURE 20. START, PREHEAT, AND TRANSFER TIME DELAY RELAYS

STOP AND RETRANSFER TIME DELAYS

Suggested settings for these time delays are 5 minutes for stopping and 10 to 20 minutes for retransfer. To change time settings, adjustable from 2 to 60 minutes, use the procedure following.

1. Open the cabinet door of the automatic transfer switch.
2. Set the time delay by turning the adjustment knob in the center of the delay. See Figure 21.

   The black pointer on the face of the time delay indicates the preset delay. The red pointer indicates the delay time left in operation.

3. Close the cabinet door.

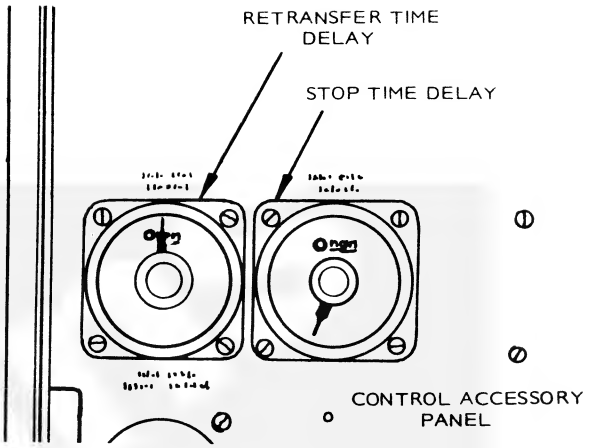


FIGURE 21. STOP AND RETRANSFER TIME DELAY RELAYS

Transfer Switch

MICROSWITCH ADJUSTMENT

Use the following procedure to adjust the microswitch and actuating lever. Be sure microswitch actuating lever is securely held in place and squarely aligned before beginning adjustments.

1. Open cabinet door of automatic transfer switch.
2. Disconnect the generator set starting battery(ies) if applicable.
3. Remove AC voltage from the automatic transfer switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to disconnect the starting battery if applicable and remove AC power before attempting service.***

4. **100 through 280 ampere OT:** Remove the twist-lock disconnect plug and open the control accessory panel.
5. **100 through 280 ampere OT:** Remove the one screw on top and one screw on bottom of meter lamp flange so you can swing the hinged panel outward.
6. Manually close the transfer switch to the side on which the microswitch is mounted (the one you want to adjust).
7. Remove the auxiliary switch cover.
8. Loosen the two long mounting screws through the brackets and adjust the switches so that there is between 1/16 and 3/32 inch (1.6 and 2.4 mm) clearance between the actuating lever and the switch body as shown in Figure 22.
9. Tighten the microswitch mounting screws making sure not to move the micro-switches during tightening.
10. Re-install the auxiliary switch cover.
11. Manually move the transfer switch back to its original position, if necessary.
12. **100 through 280 ampere OT:** Close the meter-lamp panel and secure with the two screws removed in step 5.
13. **100 through 280 ampere OT:** Close the control acessory panel and reconnect the twist-lock disconnect plug.
14. Restore AC power to the automatic transfer switch.
15. Reconnect the generator set starting batteries (if applicable).
16. Close the cabinet door.

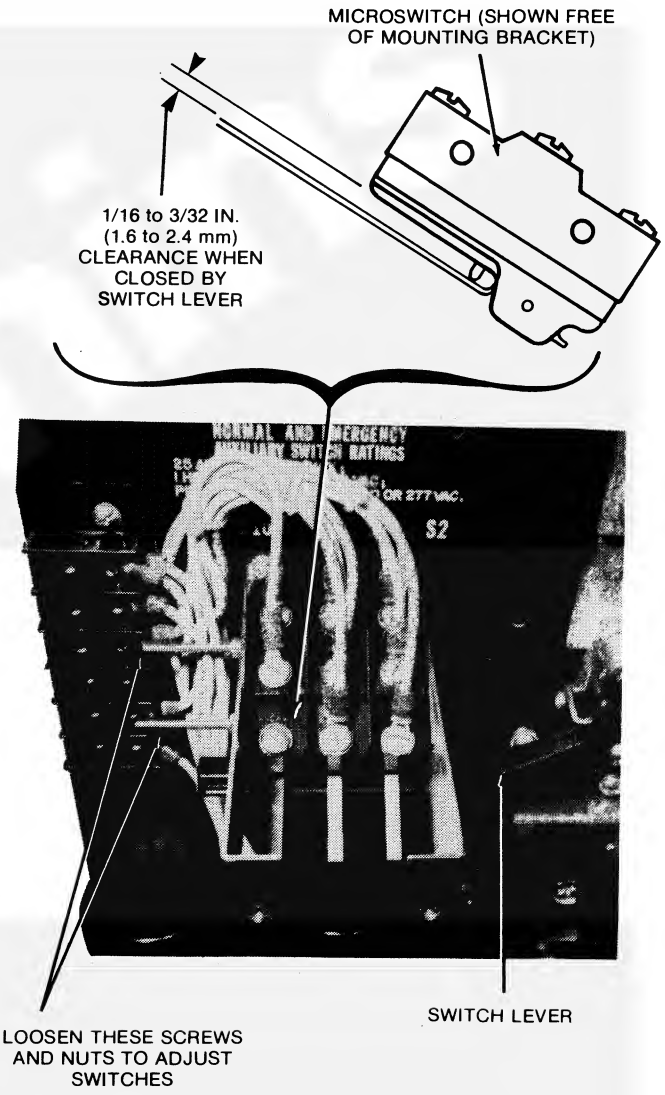


FIGURE 22. MICROSWITCH ADJUSTMENT

CHECKING LINEAR ACTUATOR

Always check the mechanical interlock and movable contacts for binding action by operating the transfer switch manually. If okay, check the linear actuator using the following procedure.

1. Open cabinet door of automatic transfer switch.
2. Disconnect the generator set starting battery(ies) if applicable.
3. Remove AC voltage from the automatic transfer switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to disconnect the starting battery if applicable and remove AC power before attempting service.***

4. **100 through 280 ampere OT:** Remove the twist-lock disconnect plug and open the control accessory panel.
5. **100 through 280 ampere OT:** Remove the one screw on top and one screw on bottom of meter-lamp panel flange so you can swing the hinged panel outward.
6. Remove the auxiliary switch cover (with actuator disconnect switch and switch nameplate) by taking out the four screws.
7. With all power removed, connect an ohmmeter to the wire lead terminals noted below. Table 2 shows the correct resistance values. If the resistance is other than that listed, replace the actuator as described under *Replacement of Linear Actuator.*
8. **100 through 280 ampere OT:** Close the meter-lamp panel and secure with the two screws removed in Step 5.
9. **100 through 280 ampere OT:** Close the control accessory panel and reconnect the twist-lock disconnect plug.
10. Restore AC power to the automatic transfer switch.
11. Reconnect the generator set starting batteries (if applicable).
12. Close the cabinet door.

TABLE 2. LINEAR ACTUATOR WINDING RESISTANCES @ 25°C (77°F)

LINEAR ACTUATOR	ACTUATOR VOLTAGE	RESISTANCE ± 10% BETWEEN RED AND WHITE LEADS
12 Coil (6.1 in. or 155 mm long)*	110-120 (50/60 Hz)	4.4 Ω
	208-240 (50/60 Hz)	16 Ω
	440-480 (50/60 Hz)	55 Ω
	347 (50/60 Hz)	45 Ω
16 Coil (8.2 in. or 207 mm long)*	208-240 (50/60 Hz)	8 Ω
	440-480 (50/60 Hz)	34 Ω
	347 (50/60 Hz)	23 Ω
8 Coil (4.2 in or 106 mm long)*	110-120 (50/60 Hz)	4.2 Ω
	208-240 (50/60 Hz)	17 Ω
	440-480 (50/60 Hz)	68 Ω
	347 (50/60 Hz)	42 Ω

*Length does not include mounting bracket

REPLACEMENT OF LINEAR ACTUATOR

100 Through 280 Ampere OT

1. Open cabinet door of automatic transfer switch.
2. Disconnect the generator set starting battery(ies) if applicable.
3. Remove AC voltage from the automatic transfer switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious injury or death unless all AC power is removed. Be sure to disconnect the starting battery if applicable and remove AC power before attempting service.***

4. **100 through 280 ampere OT:** Remove the twist-lock disconnect plug and open the control accessory panel.
5. **100 through 280 ampere OT:** Remove the one screw on top and one screw on bottom of meter-lamp panel flange so you can swing hinged panel outward.
6. Remove the auxiliary switch cover (with actuator disconnect switch and switch nameplate) by taking out the four screws and ET lock washers. See Figure 23.
7. Remove the red, transparent covers from the sides of the linear actuator.
8. Remove the actuator black, red, and white wire leads from the capacitor and circuit breaker. Note connections. (You have to remove capacitor cap to remove leads.)
9. Remove the capscrew and lock washer from each end of the actuator rod so that you can remove actuator rod end assemblies from the actuator handles. Support rod ends so you do not damage handles.
10. Slide the actuator rod out from the linear actuator.
11. Remove the four actuator mounting capscrews, lock washers, and spacers and lift off the actuator.

WARNING ***To prevent personal injury, grasp the actuator so it will not drop while removing capscrews.***

12. Mount the new linear actuator (wire leads toward bottom) with the hardware from Step 11. Be sure to connect the grounding lead with ring terminal to the one mounting capscrew (Figure 23). Snug mounting capscrews only at this time.

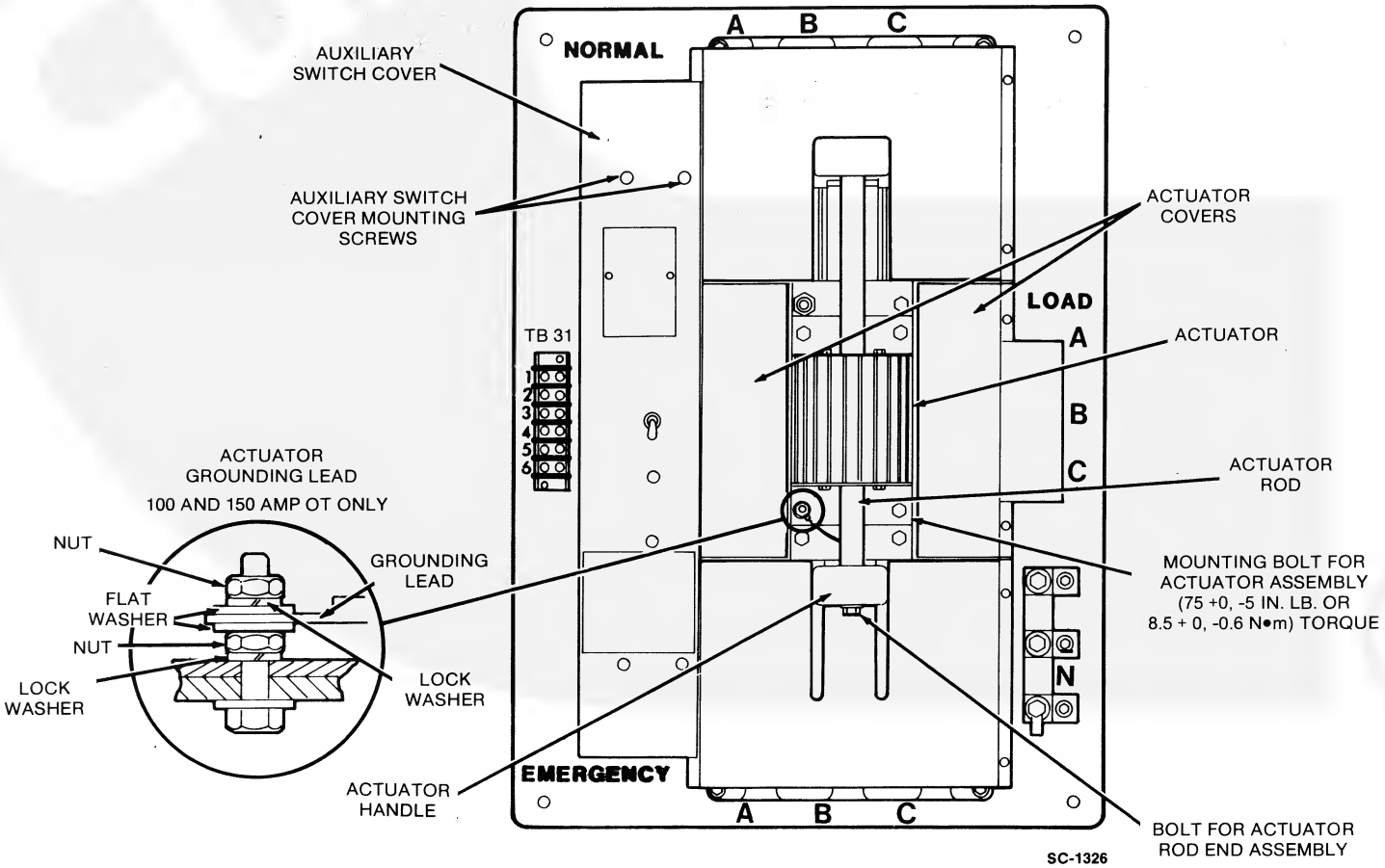


FIGURE 23. TYPICAL 100 THROUGH 280 AMPERE OT TRANSFER SWITCH

13. Move the actuator rod ground brush over to the side just enough so you can insert the actuator rod through the linear actuator. See Figure 24.
14. Insert the actuator rod end assemblies into the handles and connect to the actuator rod with the capscrews and lock washers removed in Step 10. Tighten capscrews to 135 + 0, -5 in. lb (15.2 + -0.6 N•m).
15. Align the actuator so the actuator rod has equal clearance on each side in the linear actuator opening. Then tighten actuator mounting capscrews to 75 +0, -5 in. lb. (8.5 +0, -0.6 N•m).
16. Connect the terminals of the actuator wire leads to the same terminals as was the old linear actuator.
17. Manually operate the transfer switch several times. Check general operation for actuator rod alignment, etc. Remedy if necessary.
18. Re-install the actuator covers with the screws and lock washers from Step 7.
19. Mount the auxiliary switch cover back on the transfer switch with the four screws and ET lock washers.
20. **100 through 280 ampere OT:** Close the meter-lamp panel and secure with the two screws removed in Step 5.
21. **100 through 280 ampere OT:** Close the control accessory panel and reconnect the twist-lock disconnect plug.
22. Restore AC power to the automatic transfer switch.
23. Reconnect the generator set starting batteries (if applicable).
24. Close cabinet door.

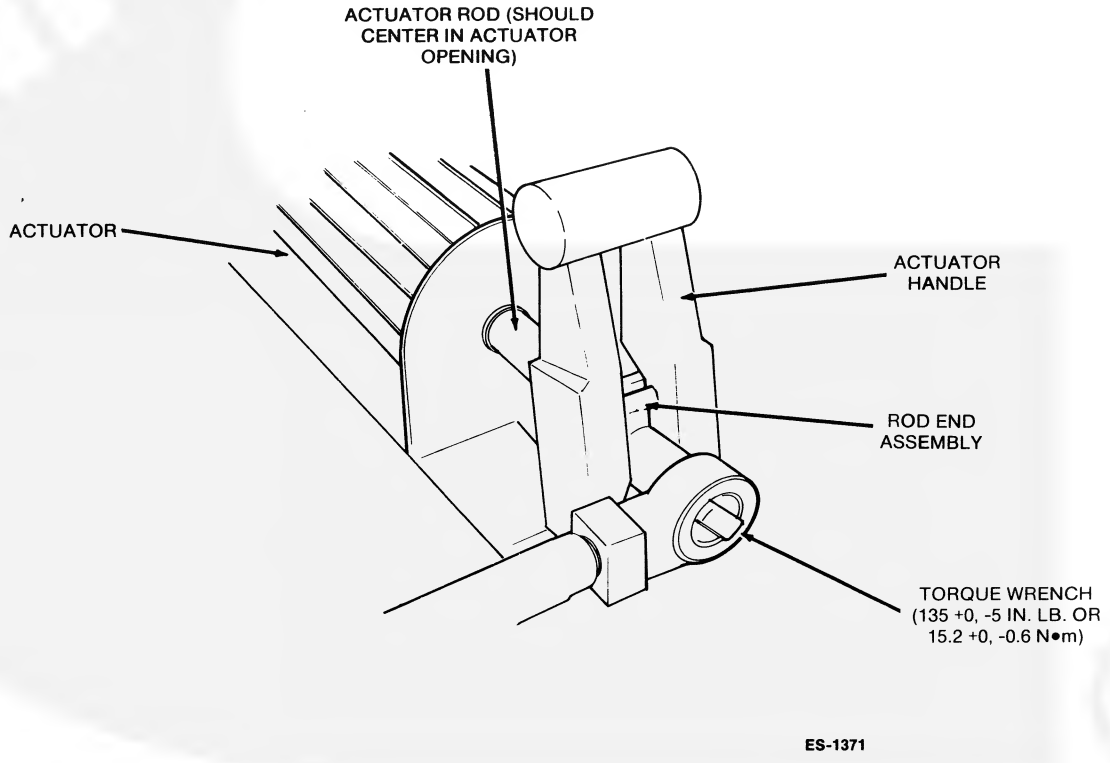


FIGURE 24. ACTUATOR AND ACTUATOR ROD INSTALLATION

400 Through 1000 Ampere OT

1. Open cabinet door of automatic transfer switch.
2. Disconnect the generator set starting battery(ies) if applicable.
3. Remove AC voltage from the automatic transfer switch. Tag disconnect.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to disconnect the starting battery if applicable and remove AC power before attempting adjustments.***

4. Remove the auxiliary switch cover (with actuator disconnect switch and switch nameplate) by taking out the four screws and ET lock washers. See Figure 25.
5. Remove the capscrew and lock washer from each end of the actuator rod so you can remove the actuator rod end assemblies from the handles. Support rod ends so you do not damage handles.
6. Slide the actuator rod out from the linear actuator.
7. Remove the actuator black, red, and white leads from the capacitor and circuit breaker. Note connections. (You will have to remove capacitor cap to remove leads.)
8. Remove the four actuator mounting capscrews, washers, and nuts and lift off the actuator.

WARNING ***To prevent personal injury, grasp the actuator so it will not drop while removing mounting capscrews.***

9. Mount the new actuator (wire leads toward bottom) with the hardware from Step 9. Be sure to connect grounding lead with ring terminal to the one mounting capscrew (Figure 25). Snug mounting capscrews and nuts only at this time.
10. Move the actuator rod ground brush over the side just far enough so you can insert the actuator rod through the linear actuator.

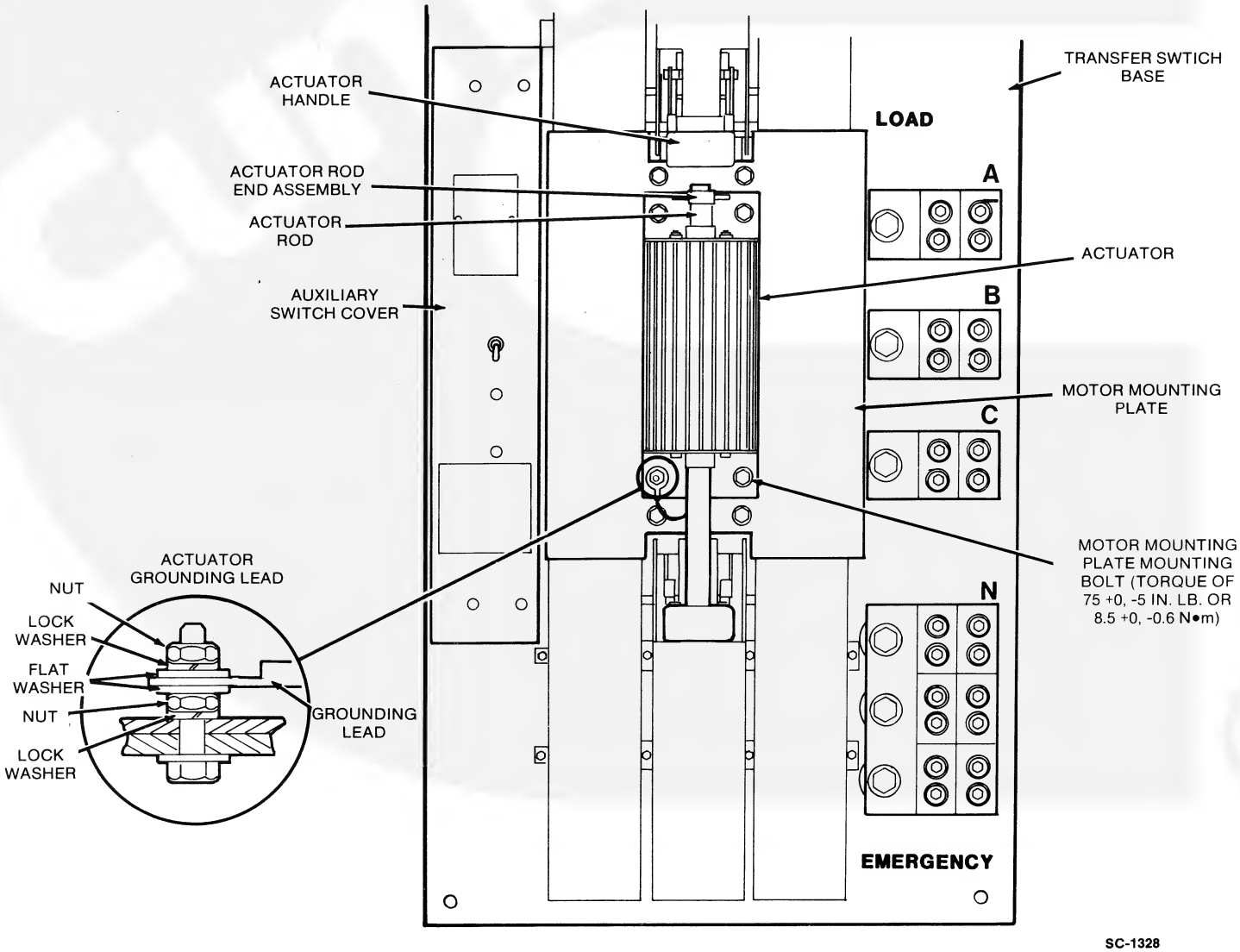


FIGURE 25. TYPICAL 400 THROUGH 1000 AMPERE OT TRANSFER SWITCH

11. Insert the actuator rod end assemblies in the handles and connect to the actuator rod with the capscrews and lock washers removed in Step 5. Tighten capscrews to 135 +0, -5 in. lb (15.2 +0, -0.6 N•m).
12. Connect the terminals of the actuator wire leads to the same terminals as the old linear actuator.
13. Manually operate the transfer switch several times. Check general operation for actuator rod alignment, etc. Remedy if necessary.
14. Mount the auxiliary switch cover back on the transfer switch with the four screws and ET lock washers.
15. Restore AC power to the automatic transfer switch.
16. Reconnect the generator set starting batteries (if applicable).

CONTACT REPLACEMENT (100 & 150 AMPERE OT)

The following describes the procedure to replace contacts on a 2- or 3-pole, 100 or 150 ampere transfer switch. However, use the same instructions for a 4-pole, switched neutral transfer switch or a rear-connected (power and load wires) transfer switch since the procedure is so similar.

1. Open the cabinet door of the automatic transfer switch.
2. Disconnect the generator set starting battery(ies) if applicable.
3. Remove AC voltage from the automatic transfer switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to disconnect the starting battery if applicable and remove AC power before attempting service.***

4. Remove the twist-lock disconnect plug and open the control accessory panel.
5. Remove the one screw on top and one screw on bottom of meter-lamp panel flange so you can swing the hinged panel outward.
6. Manually open the transfer switch on the side you want to replace the contacts.
7. Remove the red, transparent contact cover. You can first remove the auxiliary switch cover with actuator disconnect switch if this will aid removal of contact cover.
8. Remove the normal or emergency lug terminal(s) from the contact(s) you are replacing. (Remove the wires from the lugs first if this makes it easier.) See Figure 26.
9. Remove the two long capscrews, flat washers, and ET lock washers from the arc chute retainer (Figure 26).
10. Remove the arc chute retainer.
11. Remove the arc chute for the contact needing replacement. See Figure 27.

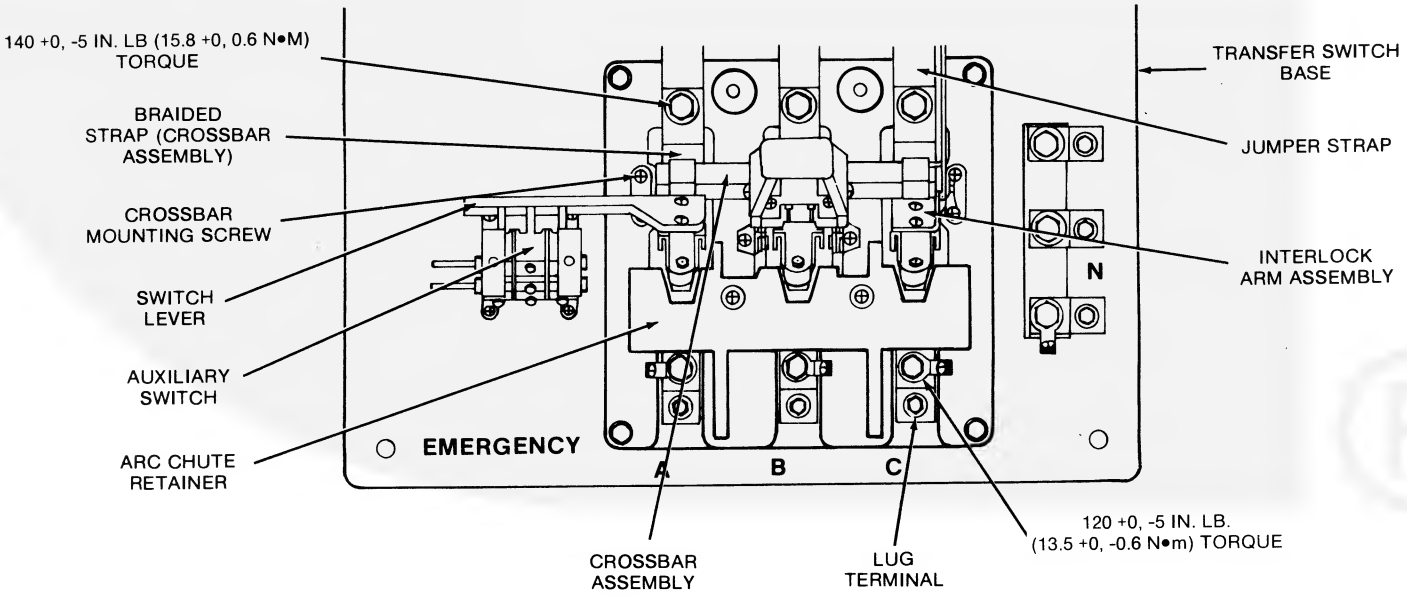


FIGURE 26. TYPICAL 100 AND 150 AMPERE OT TRANSFER SWITCH

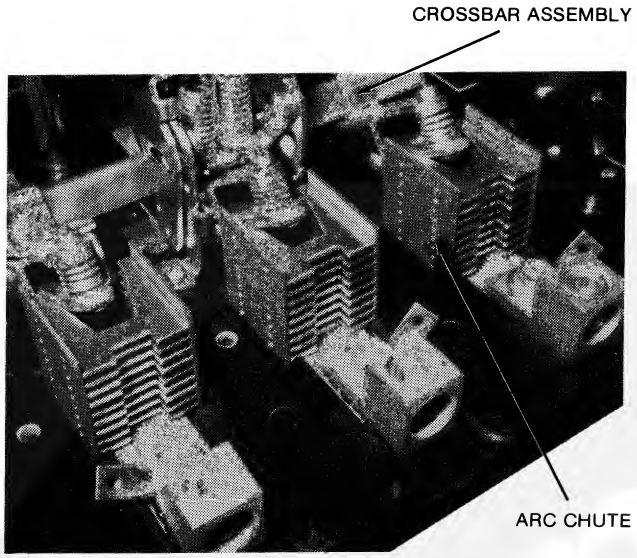


FIGURE 27. ARC CHUTE LOCATION

12. With a good Phillips screwdriver, remove the screw holding the strap (stationary contact) to the transfer switch base. See Figure 28.
13. Install the new contact strap and secure with a new screw. Tighten to a torque of 18 in. lb (2.0 N•m).
14. Using a center-punch, indent the edges of the screw in three places to lock the screw in place as had been done to the screw removed (Figure 28).

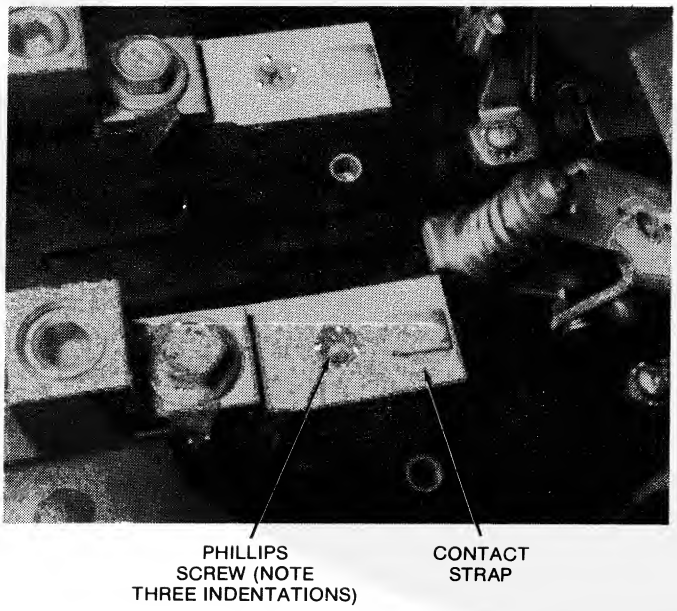


FIGURE 28. CONTACT STRAP

15. Repeat Steps 11 through 14 remaining contact strap(s).
16. Remove the rod end assembly from actuator handle (on side contacts are to be replaced). See Figure 29.

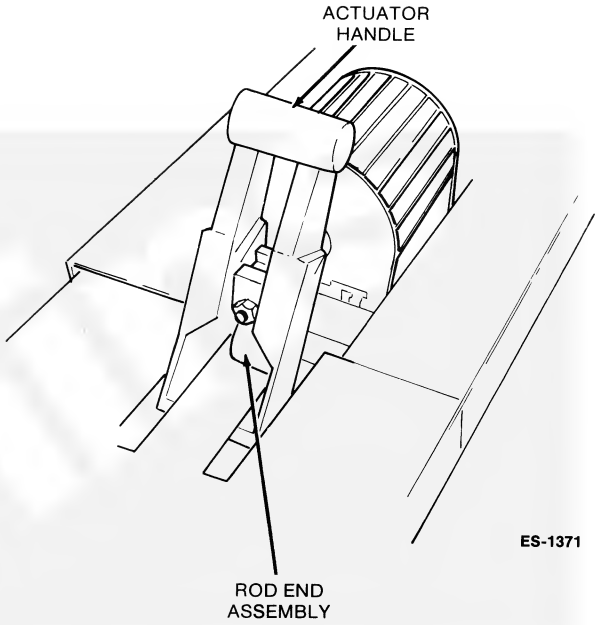


FIGURE 29. ACTUATOR HANDLE

17. Remove the switch lever which actuates microswitches from the crossbar assembly by taking out the two Phillips screws (Figure 26).
18. On the opposite end of the crossbar assembly, remove the interlock arm assembly by taking out the two Phillips screws (Figure 26).
19. Remove the hex head capscrews and washers so the crossbar assembly straps are loose (Figure 26).
20. Remove the crossbar assembly by taking out the eight Phillips screws (save screws). See Figure 26.
21. Remove the actuator handle from the old crossbar assembly and fasten it on the new crossbar assembly using existing hardware.
22. Install the new crossbar assembly in the transfer switch using the eight screws from Step 26.
23. Fasten the crossbar assembly straps to the transfer switch with the capscrews and washers from Step 19. Tighten the capscrews to a torque of 140 in. lb (15.8 N•m).
24. Install the switch lever on the crossbar assembly with the two Phillips screws as was mounted before. Be sure lever is held securely in place so that it is aligned squarely with auxiliary switches.
25. On the opposite end of the crossbar assembly, mount the interlock arm assembly on the crossbar with the two existing screws.
26. Insert the rod end assembly into the handle (Figure 29) and connect to actuator rod with capscrew and lock washer removed in Step 16. Tighten capscrew to 135 +0, -5 in. lb. (15.2 +0., -0.6 N•m).

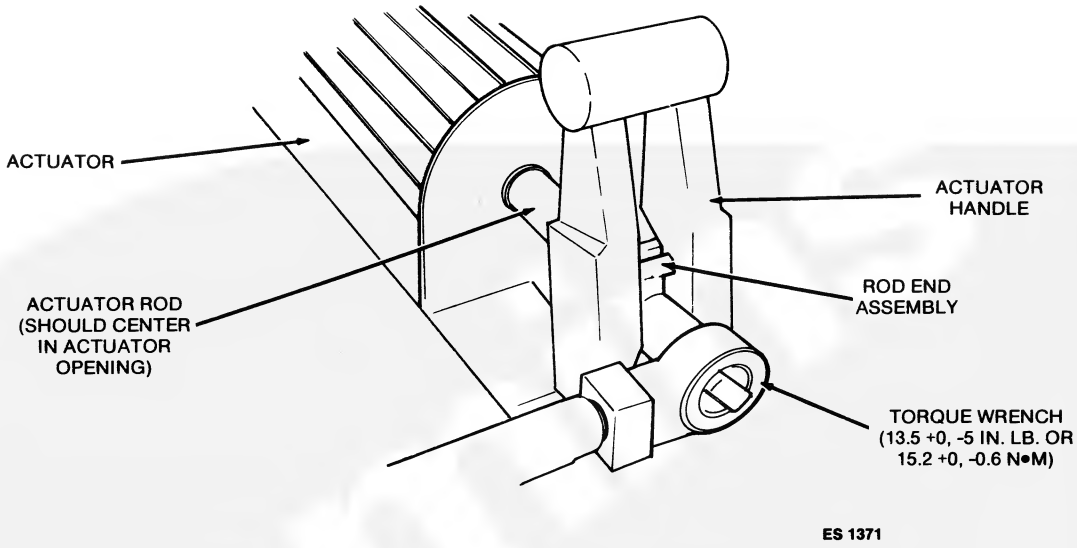


FIGURE 30. INSTALLING ROD END ASSEMBLY

27. Note actuator rod alignment in the actuator opening. It should have equal clearance on each side. If not, loosen the actuator mounting capscrews (Figure 30) and shift the actuator slightly. Then tighten actuator mounting capscrews to 75 +0, -5 in. lb (8.5 +0 -0.6 N•m).
28. Move the actuator handle so that you close the contacts just installed. Adjust the nut for each contact until it has a clearance of 0.045 to 0.078 inch (1.2 to 1.9 mm) from the arm. See Figure 31. After settings, lock each nut with glyptol.

Check contact pressure by lifting end of each contact with a spring scale. It should take a minimum force of 8 pounds (3.6 kg) to open the contact.

29. With the new arc chutes held in position, install the arc chute retainer and secure with the long washers and screws used before. Make sure the arc chutes are in correct position.

Check that the contacts of the crossbar assembly are centered in the chute and that the arc chute sides are perpendicular to the mounting base.

30. Install the lug terminals on the new contact straps. Make sure the strap has some anti-oxidant, electrical joint compound on mating surface before securing lug terminal with existing hex head bolt. Tighten bolt to torque of 120 in. lb (13.5 N•m). See Figure 26.
31. Connect the normal or emergency wires to the appropriate lug terminals.
32. Put the contacts cover back over the contacts. Also re-install auxiliary switch cover if removed.

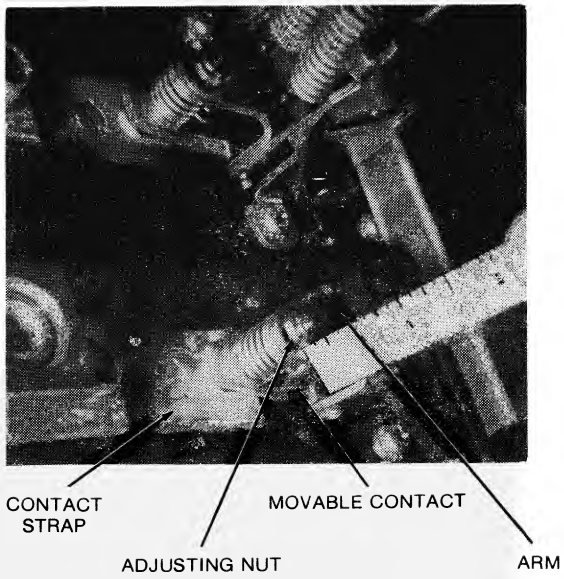


FIGURE 31. 100 AND 150 AMPERE OT CONTACT ADJUSTMENT

33. Manually move the transfer switch back to its original position before contact replacement began.
34. Close the meter-lamp panel and secure with the two screws removed in Step 5.
35. Close the control accessory panel and reconnect the twist-lock disconnect plug.
36. Restore AC power to the automatic transfer switch.
37. Reconnect the generator set starting batteries (if applicable).
38. Close the cabinet.

CONTACT REPLACEMENT, 225-280 AMPERE OT (SPEC C ONLY)

The following describes the procedure to replace contacts on a 2- or 3-pole, 225 or 280 ampere transfer switch. However, use the same instructions for a 4-pole, switched neutral transfer switch or a rear-connected (power and load wires) transfer switch since the procedure is so similar.

1. Open cabinet door of automatic transfer switch.
2. Disconnect the generator set starting battery(ies) if applicable.
3. Remove AC voltage from the automatic transfer switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to disconnect the starting battery if applicable and remove AC power before attempting service.***

4. Remove the twist-lock disconnect plug and open the control accessory panel.
5. Remove the one screw on top and one screw on bottom of meter-lamp panel flange so you can swing the hinged panel outward.
6. Manually open the transfer switch side on which you are going to replace the crossbar assembly (movable contacts).
7. Remove the red, transparent contact cover from over the crossbar assembly by taking out the four screws (Figure 32). You can first remove the auxiliary switch cover with actuator switch if this will aid removal of contact cover.
8. Remove the normal or emergency wires from the lug terminals, whichever applies.
9. Remove the one capscrew from the crossbar assembly so you can remove switch lever and interlock arm from crossbar. See Figure 34.
10. Remove the rod end asembly from the actuator handle (on side contacts to be replaced). See Figure 33.
11. Remove two actuator mounting bolts, lock washers, and actuator spacers from the crossbar mounting block with contacts which will be replaced (Figure 34).

CAUTION ***Be careful to support actuator as not to damage it since it will be supported only by the mounting capscrews on the other end.***

12. Remove the hex head capscrews and washers so the crossbar assembly straps are loose from jumper straps.
13. Remove the block and crossbar assembly by taking out the four capscrews and lock washers (Figure 34).
14. Remove the actuator handle from the crossbar assembly. (Note how it is mounted.)

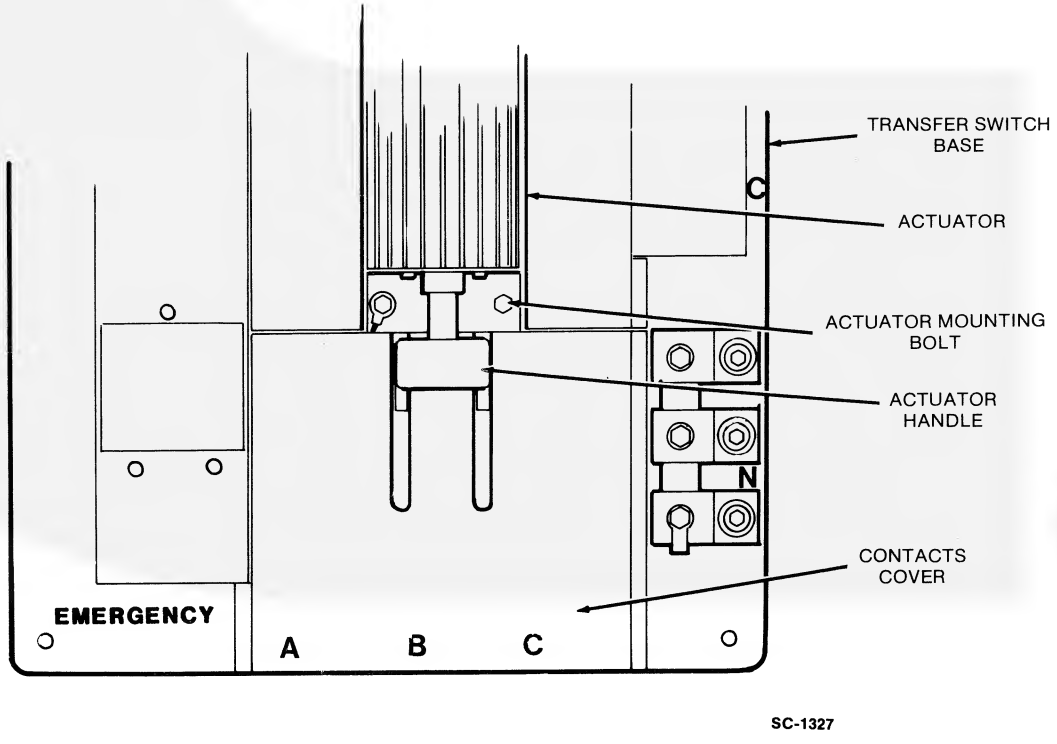


FIGURE 32. TYPICAL 225 AND 280 AMPERE OT TRANSFER SWITCH

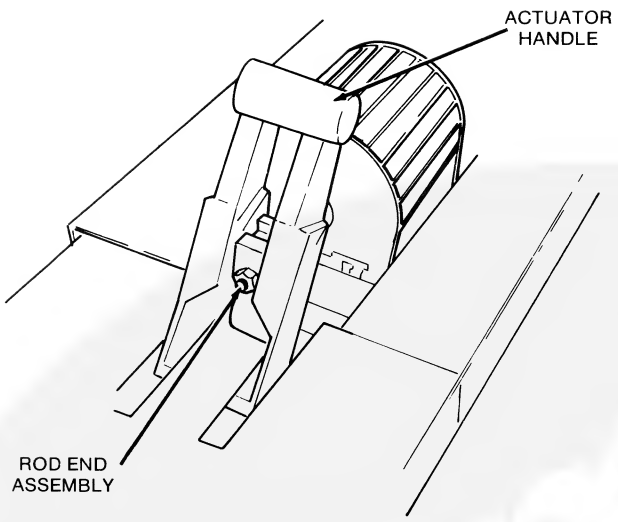


FIGURE 33. ACTUATOR HANDLE

15. Mount the actuator handle on the new block and crossbar assembly with the hardware provided (mount same way handle was mounted on old crossbar assembly).
16. Mount the new block and crossbar assembly on the transfer switch base using the capscrews and washers from Step 13. Tighten mounting bolts to 75+0,-5 in. lb (8.5+0,-0.6 N•m). See Figure 34.
17. With the hex head capscrews and washers from Step 12, secure the straps from the new block and crossbar assembly. Make sure there is some electrical anti-oxidant coating between the current-carrying surface (should still be enough coating on existing mating strap). Tighten bolted joints to a torque of 140+0,-0.5 in. lb (15.8+0,-0.6 N•m).
18. Install the two actuator spacers, actuator mounting bolts, and lock washers removed in Step 11. Tighten the bolts to a torque of 75+0,-5 in. lb (8.5+0, -0.6 N•m).
19. Mount the switch lever and interlock arm from Step 9 on the new crossbar assembly. Be sure the lever is held securely in place and that it is squarely aligned with auxiliary switches.
20. Insert the rod end assembly into the handle (Figure 35) and connect to actuator rod with capscrew and lock washer removed in Step 10. Tighten capscrew to 135+0,- 5 in. lb (15.2+0.6 N•m).
21. Note actuator rod alignment in the actuator opening. It should have equal clearance on each side. If not, loosen the actuator mounting capscrews (Figure 35) and shift the actuator slightly. Then tighten actuator mounting capscrews to 75+0,-5 in. lb (8.5+0,-0.6 N•m).
22. Connect the normal or emergency wires to the appropriate lug terminals.

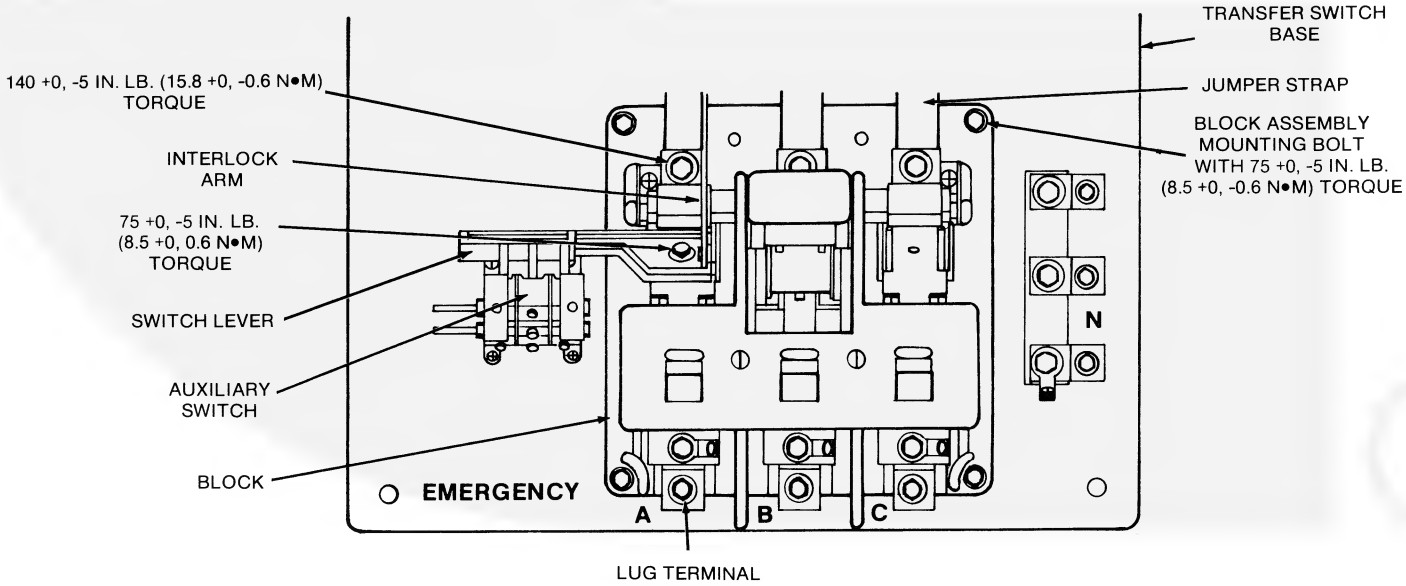


FIGURE 34. TYPICAL 225 AND 280 AMPERE OT TRANSFER SWITCH (CONTACTS COVER REMOVED)

23. Mount the contact cover back over the crossbar assembly. Also re-install auxiliary switch cover if removed.
24. Manually move the transfer switch back to its original position before contact replacement began.
25. Close the meter-lamp panel and secure with the two screws removed in Step 5.
26. Close the control accessory panel and reconnect the twist-lock disconnect plug.
27. Restore AC power to the automatic transfer switch.
28. Reconnect the generator set starting batteries (if applicable).
29. Close the cabinet door.

CONTACT REPLACEMENT (400-1000 AMPERE OT)

The following describes the procedure to replace contacts on a 2- or 3-pole, 400 through 1000 ampere transfer switch. However, use the same instructions for a 4-pole, switched neutral transfer switch or a rear-connected (power and load wires) transfer switch since the procedure is so similar.

1. Open the cabinet door of the automatic transfer switch.
2. Disconnect the generator set starting battery(ies) if applicable.
3. Remove AC voltage from the automatic transfer switch.

WARNING ***The transfer switch presents a shock hazard that might cause serious personal injury or death unless all AC power is removed. Be sure to disconnect the starting battery if applicable and remove AC power before attempting service.***

4. Manually open the transfer switch on the side you will replace the stationary contact.
5. Remove the red, transparent contact covers by pressing outward on each cover end until cover clears holding tabs, then lifting up and pulling away from transfer switch. See Figure 36.
6. Remove the normal or emergency wires from lug terminals, whichever applies (Figure 37).
7. Remove the lug terminals from the straps (contact).
8. Remove arc chute barrier by sliding out from contacts (Figure 36).
9. Remove the block assembly with contact strap. (Note if block assembly has spacers on one side held in place by block mounting bolts.) See Figure 36.

   A. Remove two mounting capscrews, internal tooth lock washers, and flat washers on right side of block assembly (emergency block assemblies, left side of block assemblies on normal side).
   B. While holding block assembly with one hand, loosen two mounting capscrews on left side (right side for block assemblies on normal side). You should now be able to remove block assembly.

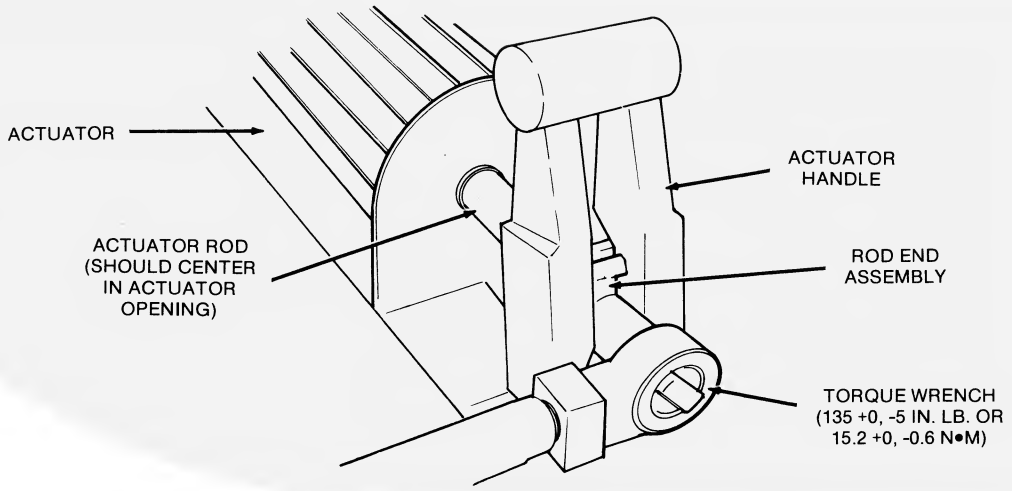


FIGURE 35. INSTALLING ROD END ASSEMBLY

10. Install new block assembly using mounting hardware from old block (use spacers if used with old block assembly). For a three- or four-pole transfer switch, do not tighten mounting capscrews until all adjacent mounting blocks (such as blocks on normal side) are replaced. Use a torque of 65 to 75 in. lb (7.3 to 8.5 N•m) on the mounting capscrews.

For 3- or 4-pole OT transfer switches, the outside power pole block assemblies must have matching part numbers (power poles A and C) due to spacers within the assemblies.

11. Mount lug terminal on new block assembly. Make sure lug terminal has anti-oxidant, electrical joint compound on mating surface before securing it with hex head bolt in block assembly. Tighten bolt to a torque of 33 +0, - 5 ft. lb (44 +0, -6 N•m).
12. Repeat Steps 8 through 11 for the other contact straps.
13. Connect the normal or emergency wires to the appropriate lug terminals.
14. Remove capscrews and lock washers from actuator rod end assemblies.
15. Slide actuator rod out of linear actuator (note ground brush against actuator rod).
16. Remove auxiliary switch cover (with actuator disconnect switch and switch nameplate), but leave wires disconnected.
17. Remove the two screws from the crossbar assembly which secure the interlock arm assembly.

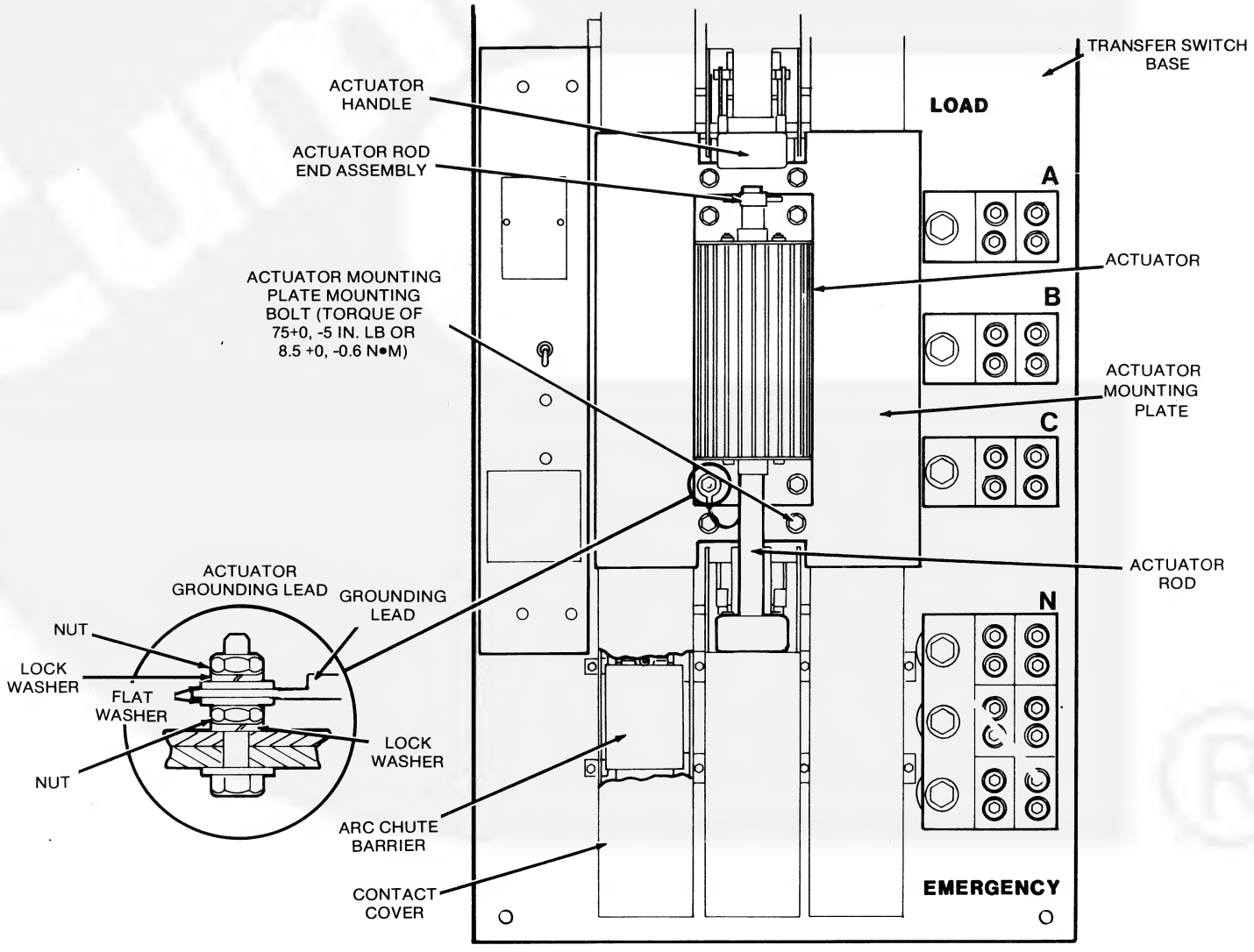


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FIGURE 36. TYPICAL 400 THROUGH 1000 AMPERE OT TRANSFER SWITCH

18. Remove the switch lever (which actuates auxiliary contacts) from the crossbar assembly by taking out two Phillips mounting screws.
19. While supporting the mounting plate, remove the four capscrews, lock washers, and mounting spacers.
20. Hang the actuator and mounting plate from the transfer switch so you still will be able to remove the crossbar assembly. (To completely remove actuator would require disconnecting wire leads, etc.)
21. Remove the capscrews and flat washers securing the straps of the crossbar assemblies to the jumper straps (bus bars).

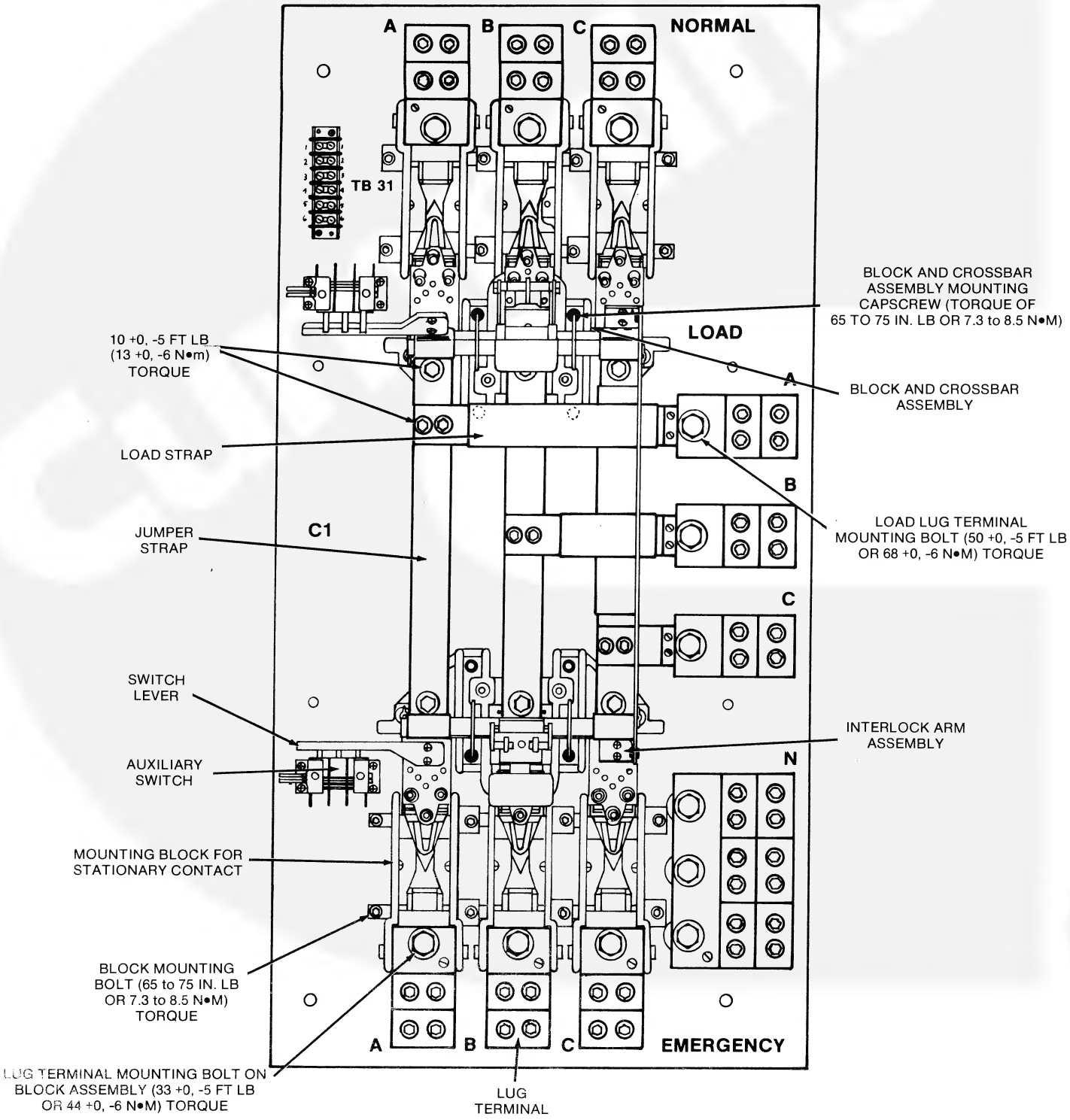

FIGURE 37. TYPICAL 400 THROUGH 1000 AMPERE OT SWITCHING ASSEMBLY

22. If replacing the top block and crossbar assembly, remove the top load assembly strap in order to get at the block and crossbar assembly's bottom capscrews.
23. Remove the mounting capscrews and washers securing the block and crossbar assembly to the transfer switch base assembly and carefully remove assembly.
24. Remove handle from crossbar assembly and mount on new crossbar assembly with the old hardware.
25. Install the new block and crossbar assembly on the transfer switch base with the capscrews and washers from Step 22. Tighten capscrews to a torque of 65 to 75 in. lb (7.3 to 8.5 N•m).
26. If the top block and crossbar assembly was replaced, reconnect the top load strap. Tighten the large capscrew on the load lug terminal mounting bolt to 50 +0, -5 ft lb (68 +0, -6 N•m) and the smaller capscrews to 10 +0, -5 ft lb (13 +0, -6 N•m). Make sure the strap mating surfaces still have a thin coat of electrical, anti-oxidant compound before reconnecting load strap. See Figure 37.
27. Connect the interlock arm assembly to the crossbar assembly with the two screws removed in Step 17.
28. On the opposite end of the crossbar assembly, mount the switch lever with the existing screws from Step 18. Be sure the lever is held securely in place and that it is squarely aligned with the auxiliary switches.
29. Mount the motor mounting plate with actuator back on transfer switch with actuator mounting spacers, lock washers, and capscrews. Do not tighten the mounting capscrews completely at this time.
30. Move the actuator rod ground brush over to the side just enough so you can insert the actuator rod through the linear actuator. See Figure 38.
31. Insert the actuator rod end assemblies into the handles and connect to the actuator rod with the capscrews and lock washers removed in Step 14. Tighten capscrews to 135 +0, -5 in. lb. (15.2 +0, -0.6 N•m).
32. Align the actuator so the actuator rod has equal clearance on each side in the linear actuator opening. Then tighten the actuator mounting place capscrews to 75 +0, -5 in. lb (8.5 +0, -0.6 N•m).
33. Mount auxiliary switch cover with actuator disconnect switch back on transfer switch.
34. Install the arc chute barriers over the arc chute.
35. Install the contact covers back on the transfer switch.
36. Manually move transfer switch back to the original position before contact replacement began.
37. Restore AC power to the automatic transfer switch.
38. Reconnect the generator set starting batteries (if applicable).
39. Close the cabinet.

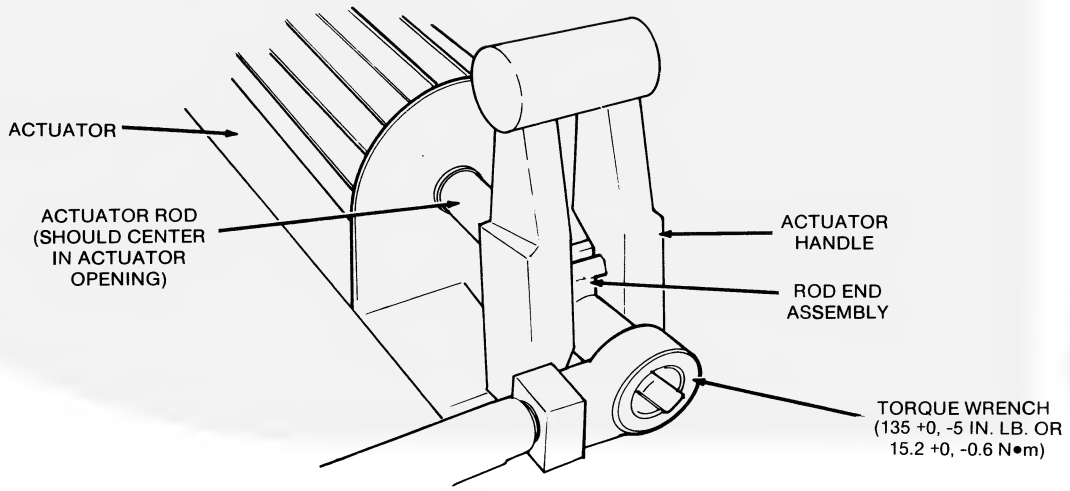

FIGURE 38. INSTALLING ROD END ASSEMBLY

Troubleshooting

This troubleshooting section is divided into four main parts, corresponding with the type control accessory panel the OT model has. Note the type panel involved and proceed to the page indicated for the appropriate troubleshooting index. (See *General Information* for description of model number system).

OTs WITH CONTROL PANEL GROUPS 10-15 OR 20-25

Find the problem below and proceed to the page indicated. Then answer the questions in the chart on that page either "YES" or "NO." Refer to the number in the column and proceed to that step, etc.

INDEX

Use of Bypass Plug or Extension Board Module — see page 90.

For modular, solid-state control accessory panels, use any tin edge contact boards still in your stock for replacement only in Spec A OT transfer switches. After depleting the stock, use only boards with gold edge contacts for all OT transfer switches (any OT can use a board with a gold edge contact).

A	OT fails to immediately connect load to line when generator set is not operating.	YES	NO
1A	Is normal line energized and delivering rated voltage to the line terminals of the transfer switch?	2A	—
2A	Is the control panel disconnect plug properly inserted into receptacle?	3A	—
3A	Is actuator switch S1 on transfer switch assembly in the up (closed) position?	4A	—
4A	Move actuator switch S1 to down (open) position. Can you operate the transfer switch manually? (Move transfer switch back to original position if you were able to operate it.)	6A	5A
5A	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
6A	Does OT have an interposing relay K1?	7A	9A
7A	Does OT have rated AC voltage between TB31-1 and TB31-2?	11A	8A
8A	Replace interposing relay K1.	—	—
9A	Are contacts K4 (3-9), K4 (3-7) for control groups 20-25, closed and making good contact?	11A	10A
10A	Replace relay K4.	—	—
11A	Does OT have programmed transition time delay K9 (located on transfer switch base)?	12A	14A
12A	Close actuator switch S1 (up position). With the control panel disconnect plug connected, jumper time delay K9 terminals 1 and 5, K9 terminals 2 and 6 for switched neutral transfer switch with two linear motors. Does transfer switch operate? **WARNING** ***High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!***	13A	14A
13A	Repair or replace time delay K9.	—	—
14A	Does OT transfer switch have two linear actuator motors (one for switching neutral)?	17A	15A
15A	Remove AC power from the OT automatic transfer switch and remove the generator set starting battery. Remove the auxiliary switch cover from the left side of the transfer switch (leave wire leads connected). With the transfer switch contacts open on the normal side, is there continuity between COMMON and NORMALLY CLOSED terminals of cutoff switch S2?	19A	16A

A	(Continued)	YES	NO
16A	Replace microswitch and adjust new microswitch as described in *TRANSFER SWITCH* section.	—	—
17A	Remove AC power from the OT automatic transfer switch and remove the generator set starting battery. Remove the auxiliary switch covers (leave wire leads connected to actuator switch S1 and circuit breaker(s) on large auxiliary switch cover). Manually operate transfer switch to open normal-side power and neutral contacts and to close those on emergency side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each normal-side auxiliary switch and continuity between COMMON and NORMALLY OPEN terminals of each emergency-side auxiliary switch. Are switches okay?	18A	16A
18A	Manually operate the transfer switch to open the emergency-side power and neutral contacts and to close those on normal side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each emergency-side auxiliary switch and continuity between COMMON and NORMALLY OPEN terminals of each normal-side auxiliary switch. Are switches okay?	19A	16A
19A	Is there continuity across actuator switch S1 terminals when the switch is in the closed (up) position?	21A	20A
20A	Replace actuator switch S1.	—	—
21A	Is there continuity across actuator circuit breaker terminals (resistance should be near zero if OK)?	23A	22A
22A	Replace circuit breaker.	—	—
23A	Measure the resistance of the linear actuator M1 windings. Table 2 of the *TRANSFER SWITCH* section lists the correct winding resistances. Replace the linear actuator if necessary.	—	—

B	**OT fails to connect load to generator set when set runs during test with load or a normal power outage.**	YES	NO
1B	Is generator output near rated AC voltage?	2B	—
2B	Has transfer time delay completed its timing cycle?	3B	—
3B	Is actuator switch S1 in the up (closed) position?	4B	—
4B	Move actuator switch S1 to down (open) position. Can you operate the transfer switch manually? (Move transfer switch back to original position if you were able to operate it.)	6B	5B
5B	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
6B	Is rated AC voltage present between terminals TB7-7 and TB7-8?	30B	7B
7B	Close actuator switch S1 (up position). Make sure disconnect plug is connected. Does transfer switch operate to close transfer switch to generator side when voltage sensor module 4 pick-up voltage knob is turned to minimum (counterclockwise)?	8B	9B
8B	Is AC input voltage to transformer T3 connected to correct primary voltage tap to give nominal 40 volts AC on T3 (X1-X2)?	9B	—
9B	Does transfer switch operate when voltage sensor module 4 is replaced by a bypass module or if K4 terminal A, K4 terminal 1 for control groups 20-25, is jumpered to ground?	10B	11B
10B	Replace voltage sensor module.	—	—
11B	Is plug-in module 8 a transfer-retransfer time delay (300-1188)?	12B	13B
12B	Does transfer switch operate if time delay module 8 is replaced by a transfer bypass plug or if K4 terminal B, K4 terminal 2 for control groups 20-25, is jumpered to TB1-6?	25B	13B
13B	Do terminals TB1-6 and TB1-7 have a transfer inhibit circuit?	14B	16B
14B	Does OT transfer load if you jumper TB1-6 to TB1-7?	15B	16B
15B	Check for malfunction in transfer inhibit circuit.	—	—
16B	Is voltage on K4 (A-B), K4 (1-2) for control groups 20-25, above 9 volts DC?	18B	17B

B	(Continued)	YES	NO
17B	Is DC voltage from TB1-GND to TB1-B+ equal to rated battery terminal voltage?	18B	19B
18B	Is DC voltage from TB3-7 to TB3-16 equal to rated battery voltage?	20B	19B
19B	Check for poor connections, defective battery, etc.	—	—
20B	Is voltage from TB3-7 to TB1-6 greater than 9 volts DC?	22B	21B
21B	Replace voltage module 5.	—	—
22B	Is voltage from TB3-7 to TB1-7 greater than 9 volts DC?	24B	23B
23B	Check circuit from TB1-6 to TB1-7. It must be closed by a jumper or external circuit.	—	—
24B	Is voltage from TB3-7 to K4-B, to K4-2 for control groups 20-25, greater than 9 volts DC?	26B	25B
25B	Replace module 8.	—	—
26B	Has relay K4 energized and are contacts K4 (4-7), K4 (4-6) for control groups 20-25, closed properly?	28B	27B
27B	Replace relay K4.	—	—
28B	Are contacts K3 (2-8), K3 (4-8) for control groups 20-25, closed to bring rated AC generator voltage down to TB6-8? Measure for rated AC voltage between TB7-7 and TB7-8.	30B	29B
29B	Replace relay K3.	—	—
30B	Does OT have an interposing relay K1?	31B	33B
31B	Is nominal AC voltage present between terminals TB31-2 and TB31-3?	33B	32B
32B	Replace interposing relay K1.	—	—
33B	Does OT have programmed transition time delay K9 (time delay K9 mounted on transfer switch base)?	34B	39B
34B	Does OT transfer load to generator set if you jumper programmed transition time delay K9 terminals 2 and 6, K9 terminals 1 and 5 for switched neutral transfer switch with two linear motors?	35B	36B
35B	Repair or replace time delay K9.	—	—
36B	Does OT transfer switch have two linear actuator motors (one for switching neutral)?	42B	37B

B	(Continued)	YES	NO
37B	Remove AC power from OT automatic transfer switch and remove generator set starting battery. Remove the auxiliary switch cover from the left side of the transfer switch (leave wire leads connected). With the transfer switch closed to the normal side, is there continuity between the COMMON and NORMALLY CLOSED terminals of cutoff switch S6?	45B	38B
38B	Replace microswitch S6 and adjust new microswitch as described in the *TRANSFER SWITCH* section.	—	—
39B	Does OT transfer switch have two linear motors (one for switching neutral)?	42B	40B
40B	Remove AC power from the OT automatic transfer switch and remove generator set starting battery. Remove the auxiliary switch cover with actuator switch S1 from the left side of the transfer switch (leave wire leads connected). With the transfer switch closed to the normal side, is there continuity between the COMMON and NORMALLY CLOSED terminals of cutoff switch S5?	45B	41B
41B	Replace microswitch S5 and adjust new microswitch as described in *TRANSFER SWITCH* section.	—	—
42B	Remove AC power from OT automatic transfer switch and remove generator set starting battery. Remove the auxiliary switch covers (leave wire leads connected to actuator switch S1 and circuit breakers on left auxiliary switch cover). Manually operate transfer switch to open normal-side power and neutral contacts and to close those on emergency side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each normal-side auxiliary switch and continuity between COMMON and NORMALLY OPEN terminals of each emergency-side auxiliary switch. Are switches okay?	43B	44B
43B	Manually operate transfer switch to open the emergency-side power and neutral contacts and to close those on the normal side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each emergency-side auxiliary contact and continuity between the COMMON and NORMALLY OPEN terminals of each normal-side auxiliary switch. Are switches okay?	45B	44B
44B	Replace defective microswitch and adjust as described in *TRANSFER SWITCH* section.	—	—
45B	Is there continuity across actuator switch S1 terminals when switch is in up (closed) position?	47B	46B
46B	Replace actuator switch S1.	—	—

B	(Continued)	YES	NO
47B	Is there continuity across actuator circuit breaker (resistance should be near zero if OK)?	49B	48B
48B	Replace circuit breaker.	—	—
49B	Measure the resistance of the linear actuator M1 windings. Table 2 of the *TRANSFER SWITCH* section lists the correct winding resistances. Replace the linear actuator if necessary.	—	—

C	OT fails to start generator set during a power outage.	YES	NO
1C	Is plug-in module 9 of control accessory panel a 2 to 3 wire converter 300-0926 with selector switch set in NORMAL position?	2C	12C
2C	Push the module 9 reset switch. If engine does not crank, place module 9 selector switch in HAND CRANK position. Can you start generator set with start switch on engine control?	3C	14C
3C	Stop generator set and move module 9 selector switch to NORMAL. Place selector switch S2 on control accessory panel to WITHOUT LOAD and test transfer switch S1 to TEST. Does generator set start?	18C	4C
4C	Jumper TB1-B+ to TB1-RMT (make sure that voltage from ground to TB1-RMT is equal to rated battery voltage). Does engine crank?	5C	6C
5C	Check circuit from TB1-B+ through control panel test transfer switch S1 (2-1) and selector switch S2 (2-3) to TB1-RMT for loose connections or open circuits.	—	—
6C	Jumper TB1-GND to TB1-3. Does engine crank?	8C	7C
7C	Check all wiring and switches between B+, GND and terminal 3 on the generator set, B+, GND and terminal 3 on TB1 in the automatic transfer switch for an open circuit.	—	—
8C	Is plug-in module 16 a preheat time delay module?	10C	9C
9C	Replace 2 to 3 wire converter module 9.	—	—
10C	Remove wire lead from J16-19. Does engine crank?	11C	9C
11C	Replace preheat time delay module 16.	—	—
12C	Is selector switch on engine control in REMOTE position?	13C	—
13C	Does generator set start, run, and stop with selector switch on generator set? Return switch to remote position.	15C	14C
14C	Refer to the generator set operator's manual and service manual.	—	—
15C	Place selector switch S2 on control accessory panel to WITHOUT LOAD and test transfer switch S1 to TEST. Does generator set start?	18C	16C

C	(Continued)	YES	NO
16C	Jumper TB1-B+ to TB1-RMT (make sure that voltage from ground to TB1-RMT is equal to rated battery voltage). Does engine crank?	17C	—
17C	Check circuit from TB1-B+ through control panel test transfer switch S1 (2-1) and selector switch S2 (2-3) to TB1-RMT for loose connections or open circuits.	—	—
18C	Move selector switch S2 on control accessory panel to WITH LOAD and test transfer switch S1 back to NORMAL. Is DC voltage from TB1-GND to TB1-6 12 volts?	20C	19C
19C	Check wire connections to voltage module 5. If OK, replace module 5.	—	—
20C	Jumper TB1-6 and J7-9. Does generator set start (allow for start time delay if used)?	21C	22C
21C	Replace interposing relay K3.	—	—
22C	Is module 7 a start-stop time delay module?	23C	25C
23C	Replace start-stop time delay module 7 with a bypass plug or jumper J7-9 to J9-2. Does generator set start?	24C	25C
24C	Replace start-stop time delay module 7.	—	—
25C	Is voltage from TB1-GND to J7-21 (J7-22 for Spec A only) about 12 volts DC?	27C	26C
26C	Replace start suppressor control A21.	—	—
27C	Begin Spec B: Replace start relay K7 (K7 contacts 4-7 do not close to connect TB1-B+ to TB1-RMT).	—	—

D	**OT fails to automatically retransfer load from generator set to normal line after normal power returns. Generator set continues to run.**	YES	NO
1D	Is control panel disconnect plug properly inserted into receptacle?	2D	—
2D	Does automatic transfer switch have an exerciser clock.	3D	4D
3D	Is exerciser turned to an exerciser period?	—	4D
4D	Does OT have battery charging feature?	5D	6D
5D	Check battery charging fuse F1. Is fuse OK?	6D	—
6D	Is rated AC voltage present at transfer switch terminals?	7D	—
7D	Move actuator switch S1 to down (open) position (some models require opening the control accessory panel for this procedure). Can you operate the transfer switch manually?	9D	8D
8D	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
9D	Does OT have area protection equipment or a remote test switch connected to terminals TB1-4 and TB1-5?	10D	12D
10D	Jumper terminals TB1-4 and TB1-5. Does OT retransfer load to normal line at end of retransfer time delay, if any?	11D	12D
11D	Check area protection equipment or remote test switch for malfunction (circuit must be closed for retransfer).	—	—
12D	Is plug-in module 8 a transfer-retransfer time delay?	13D	14D
13D	Has module 8 completed its retransfer time delay to connect about 12 volts DC to relay K3 (if not sure, measure DC voltage from TB1-GND to TB4-18)?	16D	14D
14D	Does OT transfer load to normal line if module 8 is replaced by a bypass plug ?	15D	16D
15D	Replace transfer-retransfer time delay module 8.	—	—
16D	Does control accessory panel have a manual-automatic selector switch S3 and push to retransfer switch S4?	17D	18D
17D	Place manual-automatic selector switch S3 in AUTO position. Does automatic transfer switch retransfer load to line (at end of retransfer time delay if used)?	—	18D

D	(Continued)	YES	NO
18D	Is voltage from TB1-GND to TB3-11 about 12 volts DC?	20D	19D
19D	Replace voltage module 5.	—	—
20D	Does OT have overvoltage sensor modules 13, 14, and 15 (only one in position 13 for single-phase OT)?	21D	28D
21D	Has overvoltage sensor relay K6 energized to open contacts K6 (1-7)?	22D	26D
22D	Record pick-up voltage dial settings with small pencil marks on voltage sensor modules 13, 14, and 15 (only one in position 13 for single-phase). Turn pick-up voltage knobs to 140 volts or higher. Does the OT retransfer the load to the normal line after retransfer time delay, if any.	23D	24D
23D	Recheck the normal line voltage and output voltage of transformers T2, T4, and T5 for higher than normal readings. Make sure voltages sensors are set for for correct pick-up voltages.	—	—
24D	Remove one overvoltage sensor module from the control accessory panel. Does OT transfer load to normal line after retransfer time delay, if any?	25D	26D
25D	**Three-Phase:** Isolate malfunctioning voltage sensor by plugging each individual voltage sensor module into position 15 with bypass plugs in positions 13 and 14.	—	—
	Single-Phase: Replace voltage sensor module in position 13.	—	—
26D	Jumper TB4-9 to TB4-7. Does OT transfer load to normal line after retransfer time delay, if any?	27D	28D
27D	Replace overvoltage line relay K6.	—	—
28D	Record the pick-up voltage dial settings with small pencil marks on voltage sensor modules 1, 2, and 3 (only one in position 1 for single-phase). Turn pick-up voltage knobs to 90 or below. Does the OT retransfer the load to the normal line (after retransfer time delay if any)?	29D	30D
29D	Recheck the normal line voltage and output voltage of transformers T2, T4, and T5 for lower than normal readings. Make sure voltage sensors are set for correct pick-up voltages.	—	—

D	(Continued)	YES	NO
30D	Replace voltage sensor modules 1,2, and 3 with bypass modules or jumper TB1-GND to TB4-20. Does OT retransfer load to normal line after retransfer time delay, if any?	31D	32D
31D	**Three-Phase:** Isolate malfunctioning voltage sensor by plugging each individual voltage sensor module into position 3 with bypass plugs in positions 1 and 2.	—	—
	Single-Phase: Replace voltage sensor module in position 1.	—	—
32D	Did relay K3 pick up to close contacts K3 (6-9) and open K3 (2-8) for control groups 10-15 or close contacts K3 (3-5) and open K3 (4-8) for control groups 20-25?	6A	33D
33D	Measure K3 (A-B) voltage for control groups 10-15 or K3 (1-2) voltage for control groups 20-25. If it is 9 volts DC or greater, the coil is probably open. Replace relay.	—	—

E	OT delays transferrring load to line until generator set stops after normal power outage.	YES	NO
1E	Do relay contacts K3 (6-9) close for control groups 10-15 or contacts K3 (3-5) close for control groups 20-25 as relay K3 picks up when the normal source voltage returns.	2E	3E
2E	Clean K3 contacts. Does this correct problem?	—	3E
3E	Replace relay K3.	—	—

F	Generator set starts during normal service.	YES	NO
1F	Is control panel disconnect plug properly inserted into receptacle?	2F	—
2F	Does automatic transfer switch have an exerciser clock?	3F	4F
3F	Is exerciser clock turned to the exercise period?	—	4F
4F	Record pick-up voltage dial settings with small pencil marks on voltage sensor modules 1, 2 and 3 (only one in position 1 for single-phase). Turn pick-up voltage knobs to 90 or below. Does generator set stop (after time delay)? After test, return knobs to original settings.	5F	6F
5F	Recheck the normal line voltage and output voltage of transformers T2, T4 and T5 for lower than normal readings. Make sure voltage sensors are set for correct pick-up voltage.	—	—
6F	Are modules 13, 14 and 15 overvoltage sensors (only one in position 13 for single-phase)?	7F	10F
7F	Record pick-up voltage dial settings with small pencil mark on voltage sensor modules. Turn pick-up voltage knobs to 140 volts. Does generator set stop (after time delay)? After test, return knobs to original settings.	8F	9F
8F	Recheck the normal line voltage and output voltage of transformers T2, T4 and T5 for higher than normal readings. Make sure voltage sensors are set for correct pick-up voltage.	—	—
9F	Is relay contact K6 (1-7) closed and making good contact?	10F	—
10F	Is relay K3 energized, contacts K3 (1-7) open and contacts K3 (6-9) closed properly for control groups 10-15, or contacts K3 (C/NC) open and contacts K3 (3-5) closed properly for control groups 20-25?	12F	11F
11F	Measure K3 (A-B) voltage for control groups 10-15, measure K3 (1-2) voltage for control groups 20-25. If 9 volts or more, the relay probably has an open coil. Replace relay.	—	—
12F	Remove start-stop time delay module 7 and replace with the bypass plug module. Does generator set stop?	13F	—
13F	Replace start-stop time delay module.	—	—

G	Exerciser clock fails to start generator set.	YES	NO
1G	Does exerciser motor timer M1 operate? Voltage on M1 (1-2) should be approximately 120 VAC.	2G	5G
2G	Has overcrank condition occured (note overcrank lamp on OT-E models)?	—	3G
3G	Do contacts M1 (4-5) open and contacts M1 (3-5) close to put battery voltage on TB1-RMT terminal during exercise period? See instructions for exercise clock adjustments.	1C	4G
4G	Replace the microswitch on the exerciser clock or replace exerciser clock.	—	—
5G	Is fuse F1 in control panel "blown"?	6G	—
6G	Replace fuse F1.	—	—

H	Battery Charger Malfunctions	YES	NO
1H	Does battery charger fail to charge? Charge ammeter shows zero current and battery discharges?	6H	2H
2H	Does battery charger charge at high rate and cause battery to lose electrolyte (look for bubbling)?	4H	3H
3H	Does charger supply current but battery fails to supply sufficient cranking power?	5H	—
4H	Lower charger float voltage a small amount. Measure specific gravity once a week and readjust float voltage until charger will hold recommended specific gravity without overcharging. Increase float voltage again if specific gravity drops below recommended value.	—	—
5H	Check battery under load to see if it might have a dead cell. Check specific gravity of battery electrolyte and increase float voltage a small amount (check specific gravity once per week and reset float voltage until charger will hold recommended specific gravity).	—	—
6H	Check fuse F1. Is fuse OK?	7H	—
7H	Does primary of transformer T1 have rated input on correct terminals to produce approximately 20 volts AC on T1 (X1-X2) or approximately 40 volts on T1 (X1-X3)?	8H	—
8H	Remove module 6 and measure AC voltage at J6 (15-21). Is this approximately 20 volts for OT-D or OT-E and 40 volts for OT-C?	9H	—
9H	Replace battery charger module 6 with new module.	—	—

I	Overcrank lamp lights while generator set is running. (OT-E Only)	YES	NO
1I	Is generator output voltage near normal.	2I	—
2I	Does undervoltage sensor module 4 have correct setting so that relay K4 energizes?	3I	—
3I	Is there less than 2 volts DC present between TB3-18 and TB1-GND?	8I	4I
4I	Is relay K4 energized and does OVERCRANK lamp go out if voltage sensor module 4 pick-up voltage knob is turned to minimum (counterclockwise)?	5I	6I
5I	Is input voltage to transformer T3 connected to correct primary voltage tap to give nominal 40 volts AC on T3 (X1-X2)?	6I	—
6I	Is relay K4 energized and does OVERCRANK lamp go out if you replace voltage sensor module 4 with a bypass plug?	7I	8I
7I	Replace voltage sensor module 4.	—	—
8I	Replace 2 to 3 wire converter module.	—	—

J	Overcrank lamp lights without any engine cranking (OT-E Only)	YES	NO
1J	Has a power outage occurred?	4J	2J
2J	Is control accessory panel disconnect plug removed?	3J	—
3J	Connect the disconnect plug, move the selector switch on 2 to 3 wire converter module to NORMAL. (Lamp lights if power outage occurred with selector switch in STOP or HAND CRANK positions).	—	—
4J	For generator set operation, move the selector switch on 2 to 3 wire converter module to NORMAL. (Lamp lights if power outage occurred with selector switch in STOP or HAND CRANK positions.)	—	—

OTs WITH CONTROL PANEL GROUPS 16

Find the problem below and proceed to the page indicated. Then answer the questions in the chart on that page either "YES" or "NO." Refer to the number in the column and proceed to that step, etc.

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Use of Bypass Plug or Extension Board Module — see page 90.

For modular, solid-state control accessory panels, use any tin edge contact boards still in your stock for replacement only in Spec A OT transfer switches. After depleting the stock, use only boards with gold edge contacts for all OT transfer switches (any OT can use a board with a gold edge contact).

A	OT fails to connect load to emergency power source during test with load or a normal power outage.	YES	NO
1A	Is emergency source near rated AC voltage?	2A	—
2A	Has transfer time delay completed its timing cycle?	3A	—
3A	Is transfer inhibit switch S2 closed?	4A	—
4A	Is actuator switch S1 in the up (closed) position?	5A	—
5A	Move actuator switch S1 to down (open) position. Can you operate the transfer switch manually? (Move transfer switch back to original position if you were able to operate it.)	7A	6A
6A	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
7A	Is rated AC voltage present between terminals TB7-7 and TB7-8?	24A	8A
8A	Close actuator switch S1 (up position). Make sure disconnect plug is connected. Does transfer switch operate to close transfer switch to emergency side when voltage sensor module 4 pick-up voltage knob is turned to minimum (counterclockwise)?	9A	10A
9A	Is AC input voltage to transformer T3 connected to correct primary voltage tap to give nominal 40 volts AC on T3 (X1-X2)?	10A	—
10A	Does transfer switch operate when voltage sensor module 4 is replaced by a bypass module or if K4 terminal A is jumpered to ground?	11A	12A
11A	Replace voltage sensor module.	—	—
12A	Is plug-in module 8 a transfer-retransfer time delay?	13A	15A
13A	Does transfer switch operate if time delay module 8 is replaced by a transfer bypass plug or if K4 terminal B is jumpered to TB1-6?	14A	15A
14A	Replace module 8.	—	—
15A	Do terminals TB1-6 and TB1-7 have a transfer inhibit circuit?	16A	18A
16A	Does OT transfer load if you jumper TB1-6 to TB1-7?	17A	18A
17A	Check for malfunction in transfer inhibit circuit.	—	—
18A	Is voltage on K4 (A-B) about 24 volts DC?	19A	20A

A	(Continued)	YES	NO
19A	Replace relay K4.	—	—
20A	Is voltage from TB1-GND to J5-15 about 24 VDC?	22A	21A
21A	Replace voltage module 5.	—	—
22A	Is there about 24 VDC between TB1-GND and TB3-20?	24A	23A
23A	If there is no output, replace suppression control A21.	—	—
24A	Does OT have an interposing relay K1?	25A	27A
25A	Is nominal AC voltage present between terminals TB31-2 and TB31-3?	27A	26A
26A	Replace interposing relay K1.	—	—
27A	Does OT have programmed transition time delay K9 (time delay K9 mounted on transfer switch base)?	28A	33A
28A	Does OT transfer load to generator set if you jumper programmed transition time delay K9 terminals 2 and 6, K9 terminals 1 and 5 for switched neutral transfer switch with two linear motors?	29A	30A
29A	Repair or replace time delay K9.	—	—
30A	Does OT transfer switch have two linear actuator motors (one for switching neutral)?	36A	31A
31A	Remove AC power from OT automatic transfer switch. Remove the auxiliary switch cover from the left side of the transfer switch (leave wire leads connected). With the transfer switch closed to the normal side, is there continuity between the COMMON and NORMALLY CLOSED terminals of cutoff switch S6?	39A	32A
32A	Replace microswitch S6 and adjust new microswitch as described in the *TRANSFER SWITCH* section.	—	—
33A	Does OT transfer switch have two linear motors (one for switching neutral)?	36A	34A
34A	Remove AC power from the OT automatic transfer switch. Remove the auxiliary switch cover with actuator switch S1 from the left side of the transfer switch (leave wire leads connected). With the transfer switch closed to the normal side, is there continuity between the COMMON and NORMALLY CLOSED terminals of cutoff switch S5?	39A	35A

A	(Continued)	YES	NO
35A	Replace microswitch S5 and adjust new microswitch as described in *TRANSFER SWITCH* section.	—	—
36A	Remove AC power from OT automatic transfer switch. Remove the auxiliary switch covers (leave wire leads connected to actuator switch S1 and circuit breakers on left auxiliary switch cover). Manually operate transfer switch to open normal-side power and neutral contacts and to close those on emergency side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each normal-side auxiliary switch and continuity between COMMON and NORMALLY OPEN terminals of each emergency-side auxiliary switch. Are switches okay?	37A	38A
37A	Manually operate transfer switch to open the emergency-side power and neutral contacts and to close those on the normal side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each emergency-side auxiliary contact and continuity between the COMMON and NORMALLY OPEN terminals of each normal-side auxiliary switch. Are switches okay?	39A	38A
38A	Replace defective microswitch and adjust as described in *TRANSFER SWITCH* section.	—	—
39A	Is there continuity across actuator switch S1 terminals when switch is in up (closed) position?	41A	40A
40A	Replace actuator switch S1.	—	—
41A	Is there continuity across actuator circuit breaker (resistance should be near zero if OK)?	43A	42A
42A	Replace circuit breaker.	=	=
43A	Measure the resistance of the linear actuator M1 windings. Table 2 of the *TRANSFER SWITCH* section lists the correct winding resistances. Replace the linear actuator if necessary.	—	—

B	OT fails to automatically retransfer load from emergency source to normal line after normal power returns.	YES	NO
1B	Is control panel disconnect plug properly inserted into receptacle?	2B	—
2B	Is rated AC voltage present at transfer switch terminals?	3B	—
3B	Move actuator switch S1 to down (open) position (some models require opening the control accessory panel for this procedure). Can you operate the transfer switch manually?	5B	4B
4B	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
5B	Does OT have area protection equipment or a remote test switch connected to terminals TB1-4 and TB1-5?	6B	8B
6B	Jumper terminals TB1-4 and TB1-5. Does OT retransfer load to normal line at end of retransfer time delay, if any?	7B	8B
7B	Check area protection equipment or remote test switch for malfunction (circuit must be closed for retransfer).	—	—
8B	Is plug-in module 8 a transfer-retransfer time delay?	9B	12B
9B	Has module 8 completed its retransfer time delay to connect about 24 volts DC to relay K3 (if not sure, measure DC voltage from TB1-GND to TB4-18)?	12B	10B
10B	Does OT transfer load to normal line if module 8 is replaced by a bypass plug?	11B	12B
11B	Replace transfer-retransfer time delay module 8.	—	—
12B	Record the pick-up voltage dial settings with small pencil marks on voltage sensor modules 1, 2, and 3 (only one in position 1 for single-phase). Turn pick-up voltage knobs to 90 or below. Does the OT retransfer the load to the normal line (after retransfer time delay if any)?	13B	14B
13B	Recheck the normal line voltage and output voltage of transformers T2, T4, and T5 for lower than normal readings. Make sure voltage sensors are set for correct pick-up voltages.	—	—
14B	Replace voltage sensor modules 1, 2, and 3 with bypass modules or jumper TB1-GND to TB4-20. Does OT retransfer load to normal line after retransfer time delay, if any?	15B	16B
15B	**Three-Phase:** Isolate malfunctioning voltage sensor by plugging each individual voltage sensor module into position 3 with bypass plugs in positions 1 and 2. **Single-Phase:** Replace voltage sensor module in position 1.	—	—

B	(Continued)	YES	NO
16B	Did relay K3 pick up to close contacts K3 (6-9) and open K3 (2-8)?	21B	17B
17B	Measure K3 (A-B) voltage. Is voltage about 24 VDC?	18B	19B
18B	Replace relay K3.	—	—
19B	Is voltage from TB1-GND to TB3-11 about 24 VDC?	21B	20B
20B	Replace voltage module 5.	—	—
21B	Does OT have an interposing relay K1?	22B	24B
22B	Does OT have rated AC voltage between TB31-1 and TB31-2?	24B	23B
23B	Replace interposing relay K1.	—	—
24B	Does OT have programmed transition time delay K9 (located on transfer switch base)?	25B	27B
25B	Close actuator switch S1 (up position). With the control panel disconnect plug connected, jumper time delay K9 terminals 1 and 5, K9 terminals 2 and 6 for switched neutral transfer switch with two linear motors. Does transfer switch operate? **WARNING** ***High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!***	26B	27B
26B	Repair or replace time delay K9.	—	—
27B	Does OT transfer switch have two linear actuator motors (one for switching neutral)?	30B	28B
28B	Remove AC power from the OT automatic transfer switch. Remove the auxiliary switch cover from the left side of the transfer switch (leave wire leads connected). With the transfer switch contacts open on the normal side, is there continuity between COMMON and NORMALLY CLOSED terminals of cutoff switch S2?	32B	29B

B	(Continued)	YES	NO
29B	Replace microswitch and adjust new microswitch as described in *TRANSFER SWITCH* section.	—	—
30B	Remove AC power from the OT automatic transfer switch. Remove the auxiliary switch covers (leave wire leads connected to actuator switch S1 and circuit breaker(s) on large auxiliary switch cover). Manually operate transfer switch to open normal-side power and neutral contacts and to close those on emergency side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each normal-side auxiliary switch and continuity between COMMON and NORMALLY OPEN terminals of each emergency-side auxiliary switch. Are switches okay?	31B	29B
31B	Manually operate the transfer switch to open the emergency-side power and neutral contacts and to close those on normal side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each emergency-side auxiliary switch and continuity between COMMON and NORMALLY OPEN terminals of each normal-side auxiliary switch. Are switches okay?	32B	29B
32B	Is there continuity across actuator switch S1 terminals when the switch is in the closed (up) position?	34B	33B
33B	Replace actuator switch S1.	—	—
34B	Is there continuity across actuator circuit breaker terminals (resistance should be near zero if OK)?	36B	35B
35B	Replace circuit breaker.	—	—
36B	Measure the resistance of the linear actuator M1 windings. Table 2 of the *TRANSFER SWITCH* section lists the correct winding resistances. Replace the linear actuator if necessary.	—	—

OTs WITH CONTROL PANEL GROUPS 17

Find the problem below and proceed to the page indicated. Then answer the questions in the chart on that page either "YES" or "NO." Refer to the number in the column and proceed to that step, etc.

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Use of Bypass Plug or Extension Board Module — see page 90.

For modular, solid-state control accessory panels, use any tin edge contact boards still in your stock for replacement only in Spec A OT transfer switches. After depleting the stock, use only boards with gold edge contacts for all OT transfer switches (any OT can use a board with a gold edge contact).

A	OT fails to connect load to generator set #2 during either a test mode or from failure of generator set #1 scheduled for run.	YES	NO
1A	Is generator output of generator set just started near rated AC voltage?	2A	—
2A	Has transfer time delay completed its timing cycle?	3A	—
3A	Is actuator switch S1 in the up (closed) position?	4A	—
4A	If test switch is not in TEST position for a test mode, is it in center (closed) position?	5A	—
5A	Move actuator switch S1 to down (open) position. Can you operate the transfer switch manually? (Move transfer switch back to original position if you were able to operate it.)	7A	6A
6A	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
7A	Is rated AC voltage present between terminals TB7-7 and TB7-8?	24A	8A
8A	Close actuator switch S1 (up position). Make sure disconnect plug is connected. Does transfer switch operate to close transfer switch to generator side when voltage sensor module pick-up voltage knob is turned to minimum (counterclockwise)?	9A	10A
9A	Is AC input voltage to transformer T3 connected to correct primary voltage tap to give nominal 40 volts AC on T3 (X1-X2)?	10A	—
10A	Does transfer switch operate when voltage sensor module 7 is replaced by a bypass module or if K6 terminal A is jumpered to ground?	11A	12A
11A	Replace voltage sensor module.	—	—
12A	Does transfer switch operate if K6 terminal B is jumpered to TB3-14?	19A	13A
13A	Is voltage on K6 (A-B) above 9 volts DC?	20A	14A
14A	Is DC voltage from TB1-GND to TB1-B+ equal to rated battery terminal voltage?	16A	15A
15A	Check for poor connections, defective battery, etc.	—	—
16A	Is voltage from TB3-7 to TB3-14 greater than 9 volts DC?	18A	17A
17A	Replace voltage module 5.	—	—

A	(Continued)	YES	NO
18A	Is voltage from TB3-7 to K6-B greater than 9 volts DC?	20A	19A
19A	Replace module 8.	—	—
20A	Has relay K6 energized and are contacts K6 (4-7) closed properly?	22A	21A
21A	Replace relay K6.	—	—
22A	Are contacts K5 (2-8) closed to bring rated AC generator voltage down to TB6-8? Measure for rated AC voltage between TB7-7 and TB7-8.	24A	23A
23A	Replace relay K5.	—	—
24A	Does OT have an interposing relay K1?	25A	27A
25A	Is nominal AC voltage present between terminals TB31-2 and TB31-3?	27A	26A
26A	Replace interposing relay K1.	—	—
27A	Does OT have programmed transition time delay K9 (time delay K9 mounted on transfer switch base)?	28A	32A
28A	Does OT transfer load to generator set if you jumper programmed transition time delay K9 terminals 2 and 6, K9 terminals 1 and 5 for switched neutral transfer switch with two linear motors?	29A	30A
29A	Repair or replace time delay K9.	—	—
30A	Remove AC power from OT automatic transfer switch (stop generator sets and remove generator set starting batteries). Remove the auxiliary switch cover from the left side of the transfer switch (leave wire leads connected). With the transfer switch closed to the normal side, is there continuity between the COMMON and NORMALLY CLOSED terminals of cutoff switch S6?	34A	31A
31A	Replace microswitch S6 and adjust new microswitch as described in the *TRANSFER SWITCH* section.	—	—
32A	Remove AC power from the OT automatic transfer switch (stop generator sets and remove generator set starting batteries). Remove the auxiliary switch cover with actuator switch S1 from the left side of the transfer switch (leave wire leads connected). With the transfer switch closed to the normal side, is there continuity between the COMMON and NORMALLY CLOSED terminals of cutoff switch S5?	34A	33A
33A	Replace microswitch S5 and adjust new microswitch as described in *TRANSFER SWITCH* section.	—	—

A	(Continued)	YES	NO
34A	Is there continuity across actuator switch S1 terminals when switch is in up (closed) position?	36A	35A
35A	Replace actuator switch S1.	—	—
36A	Is there continuity across actuator circuit breaker (resistance should be near zero if OK)?	38A	37A
37A	Replace circuit breaker.	—	—
38A	Measure the resistance of the linear actuator M1 windings. Table 2 of the *TRANSFER SWITCH* section lists the correct winding resistances. Replace the linear actuator if necessary.	—	—

B	OT fails to connect load to generator set #1 during either a test mode or from failure of generator set #2 scheduled for run.	YES	NO
1B	Is control panel disconnect plug properly inserted into receptacle?	2B	—
2B	If test switch is not in test position for a test mode, is it in center position?	3B	—
3B	Is actuator switch S1 in down (closed) position?	4B	—
4B	Is rated AC voltage present at transfer switch terminals for generator set #1 (normal) terminals?	5B	—
5B	Move actuator switch S1 to down (open) position (some models require opening the control accessory panel for this procedure). Can you operate the transfer switch manually?	7B	6B
6B	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
7B	Has module 4 completed its retransfer time delay to connect about 12 volts DC to relay K5 (if not sure, measure DC voltage from TB1-GND to K5-B?	10B	8B
8B	Does OT transfer load to normal line if you jumper TB1-B+ to K5-B?	9B	10B
9B	Replace transfer-retransfer time delay module 4.	—	—
10B	Record the pick-up voltage dial setting with small pencil mark on voltage sensor module 1. Turn pick-up voltage knob to 90 or below. Does the OT transfer load to generator set #1 (after retransfer time delay if any)?	11B	12B
11B	Recheck generator set #1 voltage and output voltage of transformer T2 for lower than normal readings. Make sure voltage sensor is set for correct pick-up voltages.	—	—
12B	Replace voltage sensor module 1 with bypass module or jumper TB1-GND to TB3-11. Does OT transfer load to generator set #1 after retransfer time delay?	13B	14B
13B	Replace voltage sensor module in position 1 (single-phase).	—	—
14B	During test or failure of generator set #2, do K6 contacts 3-9 close to connect power from generator set #1 to transformer T2 primary? (Relay K6 is de-energized during a test or if generator set #2 failed during its scheduled run.)	16B	15B

B	(Continued)	YES	NO
15B	Replace relay K6.	—	—
16B	Does OT have rated AC voltage between TB31-1 and TB31-2?	18B	17B
17B	Replace interposing relay K1.	—	—
18B	Does OT have programmed transition time delay K9 (located on transfer switch base)?	19B	21B
19B	Close actuator switch S1 (up position). With the control panel disconnect plug connected, jumper time delay K9 terminals 1 and 5. Does transfer switch operate? **WARNING** ***High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!***	20B	21B
20B	Repair or replace time delay K9.	—	—
21B	Remove AC power from the OT automatic transfer switch (stop generator sets and remove the generator set starting batteries). Remove the auxiliary switch cover from the left side of the transfer switch (leave wire leads connected). With the transfer switch contacts open on the normal side, is there continuity between COMMON and NORMALLY CLOSED terminals of cutoff switch S2?	23B	22B
22B	Replace microswitch and adjust new microswitch as described in *TRANSFER SWITCH* section.	—	—
23B	Is there continuity across actuator switch S1 terminals when the switch is in the closed (up) position?	25B	24B
24B	Replace actuator switch S1.	—	—
25B	Is there continuity across actuator circuit breaker terminals (resistance should be near zero if OK)?	27B	26B
26B	Replace circuit breaker.	—	—
27B	Measure the resistance of the linear actuator M1 windings. Table 2 of the *TRANSFER SWITCH* section lists the correct winding resistances. Replace the linear actuator if necessary.	—	—

C	**OT fails to start generator set #2 during scheduled changeover from generator set #1.**	YES	NO
1C	Is the test transfer switch S1 in the center (NORMAL) position?	2C	—
2C	Is time switch turned to correct day and time (ADJUSTMENTS section gives setting procedure)?	3C	—
3C	Is time switch M1 operating? Voltage on M1 (1-2) should be about 120 VAC.	6C	4C
4C	Is fuse F1 on control panel "blown?"	5C	6C
5C	Replace fuse F1 with same size and rating fuse.	—	—
6C	Do M1 contacts (4-5) open and M1 contacts (3-5) close if set to correct time?	8C	7C
7C	Replace microswitch on time switch or replace time switch assembly.	—	—
8C	Has overcrank condition occurred (note generator failure lamp)?	—	9C
9C	For two-wire starting, operation selector switches on generator sets are set at REMOTE. For three-wire starting, operation selector switches on OT control modules 5 and 11 are set at NORMAL. Are switches set correctly?	10C	—
10C	Does the generator set have a two-wire start control (for Onan liquid-cooled generator sets)?	11C	12C
11C	Can you start generator set #2 with the operation selector switch on the generator set? (Move switch back to original position after test.)	14C	13C
12C	For a generator set with three-wire starting, move the operation selector switch on the OT to HAND CRANK. Can you start generator set at the engine control? (Move switch back to original position after test.)	15C	13C
13C	See the generator set operator's manual and service manual.	—	—
14C	Jumper TB1-B+ to TB1-RMT for generator set #2 (two-wire start). Does generator set start?	17C	16C
15C	Jumper TB1-GND to TB1-3 for generator set #2 (three-wire start). Does generator set start?	17C	16C
16C	Check all wiring and switches between TB1 in OT and remote terminal block in generator set for an open.	—	—

C	(Continued)	YES	NO
17C	Is voltage between TB1-GND and TB3-14 about 12 VDC?.	19C	18C
18C	Replace voltage module A10.	—	—
19C	Has relay K7 energized to connect B+ to start-stop time delay module 9 (voltage between TB1-GND and TB4-5 should be about 12 VDC for this test)?	21C	20C
20C	Replace relay K7.	—	—
21C	Replace start-stop time delay module 9 with a bypass plug, or jumper TB3-12 to relay K2-B. Does generator set #2 start?	22C	23C
22C	Replace start-stop time delay module 9.	—	—
23C	Does the generator set have two-wire starting (for Onan liquid-cooled generator sets)?	24C	25C
24C	Do relay contacts K2 (6-9) close to connect B+ to TB1-RMT for generator set #2?	16C	26C
25C	Do relay contacts K2 (4-7) close to connect B+ to two to three wire converter module 11 terminal 10?	27C	26C
26C	Replace relay K2.	—	—
27C	Check wire between module 11 terminal 4 and TB1-3 for generator set #2. If okay, replace two to three wire converter module 11.	—	—

D	OT fails to start generator set #1 during scheduled changeover from generator set #2.	YES	NO
1D	Is the test transfer switch S1 in the center (NORMAL) position?	2D	—
2D	Is time switch turned to correct day and time (ADJUSTMENTS section gives setting procedure)?	3D	—
3D	Is time switch operating? Voltage on M1 (1-2) should be about 120 VAC.	6D	4D
4D	Is fuse F1 on control panel "blown?"	5D	6D
5D	Replace fuse F1 with same size and rating fuse.	—	—
6D	Do M1 contacts (3-5) open and contacts (4-5) close?	8D	7D
7D	Replace microswitch on time switch or replace time switch assembly.	—	—
8D	Has overcrank condition occurred?	—	9D
9D	For two-wire starting, operation selector switches on generator sets are set at REMOTE. For three-wire starting, operation selector switches on OT control modules 5 and 11 are set at NORMAL. Are switches set correctly?	10D	—
10D	Does the generator set have a two-wire start control (for Onan liquid-cooled generator sets)?	11D	12D
11D	Can you start generator set #1 with the operation selector switch on the generator set? (Move switch back to original position after test.)	14D	13D
12D	For a generator set with three-wire starting, move the operation selector switch on the OT to HAND CRANK. Can you start generator set at the engine control? (Move switch back to original position after test.)	15D	13D
13D	See the generator set operator's manual and service manual.	—	—
14D	Jumper TB1-B+ to TB1-RMT for generator set #1 (two-wire start). Does generator set start?	17D	16D
15D	Jumper TB1-GND to TB1-3 for generator set #1 (three-wire start). Does generator set start?	17D	16D
16D	Check all wiring and switches between TB1 in OT and remote terminal block in generator set for an open.	—	—
17D	Is voltage between TB1-GND and TB3-14 about 12 VDC?	19D	18D

D	(Continued)	YES	NO
18D	Replace voltage module A10.	—	—
19D	Replace start-stop time delay module 3 with a bypass plug, or jumper TB3-12 to relay K3-B. Does generator set #1 start?	20D	21D
20D	Replace start-stop time delay module 3.	—	—
21D	Does the generator set have two-wire starting (for Onan liquid-cooled generator sets)?	22D	23D
22D	Do relay contacts K3 (6-9) close to connect B+ to TB1-RMT for generator set #1?	16D	24D
23D	Do relay contacts K3 (4-7) close to connect B+ to two to three wire converter module 5 terminal 10?	25D	24D
24D	Replace relay K3.	—	—
25D	Check wire between module 5 terminal 4 and TB1-3 for generator set #1. If okay, replace two to three wire converter module 5.	—	—

USE OF BYPASS PLUG OR EXTENSION BOARD MODULE

A bypass module can bypass the operation of the voltage sensors, start-stop time delay, transfer time delay or retransfer time delay. The extension board module extends the voltage sensor or time delay out from the control accessory panel to expose printed circuit components for troubleshooting, testing, etc. Follow these instructions for the particular module.

Extension Board Module

1. Open cabinet door of automatic transfer switch.
2. Move the operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control, or in cabinet for three-wire starting with OT-E control). Tag selector switch.
3. Remove the twist-lock disconnect plug.
4. Open the control accessory panel.
5. Remove the plug-in module.
6. Note position and remove keying plug(s) from the printed circuit board receptacle by sliding the plug(s) to the right.
7. Insert extension board module into receptacle.
8. Insert module removed in Step 5 into the back of the extension module (Figure 39).
9. Close control accessory panel and reconnect disconnect plug.

WARNING ***Module extended from extension board is now energized and can cause serious personal injury or death. Proceed with care!***

10. Perform module adjustments or tests using appropriate instructions.
11. When the tests, etc. are completed, remove twist-lock disconnect plug and open control accessory panel.
12. Remove both modules from the control accessory panel.
13. Reinsert keying plug(s) removed in Step 6, into printed circuit board receptacle.
14. Plug in module removed in Step 5 or install new module, if required, into control accessory panel.
15. Close control accessory panel and connect disconnect plug.
16. Move the operation selector switch to REMOTE on engine control for two-wire starting with OT-C or OT-D control, or move operation selector switch in OT-E cabinet to NORMAL for three-wire starting, whichever applies.
17. Close cabinet door.

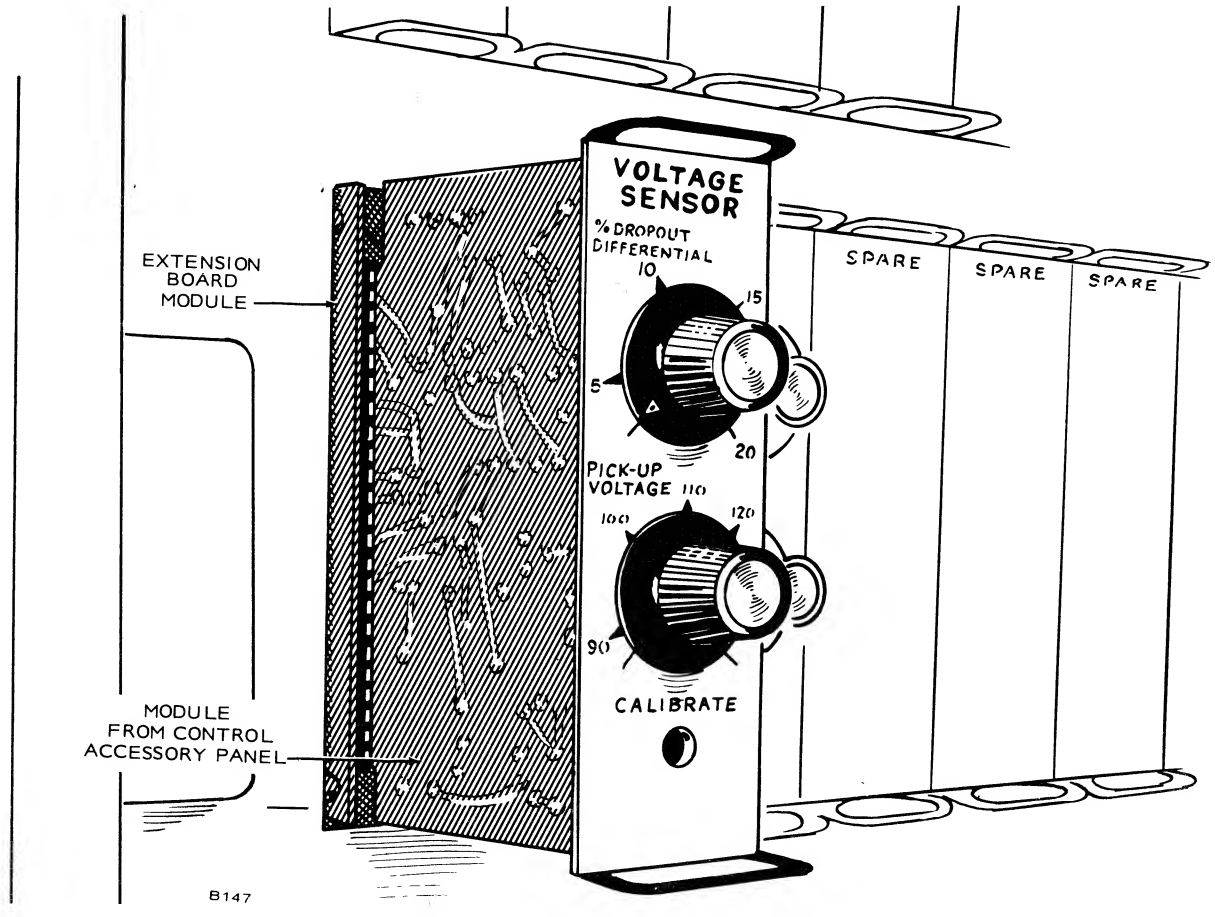

FIGURE 39. EXTENSION BOARD MODULE IN CONTROL ACCESSORY PANEL

Voltage Sensor, Transfer-Retransfer Time Delay Bypass Plug

Use a 300-1675 bypass plug module for begin Spec B automatic transfer switches, a 300-0927 bypass plug module for Spec A automatic transfer switches. Do not use this bypass module for start-stop time delay module 7, but rather use a start-stop bypass plug module.

1. Open cabinet door of automatic transfer switch.
2. Move the operation selector switch to STOP on engine control for two-wire starting with OT-C or OT-D control, or in cabinet for three-wire starting with OT-E control. Tag selector switch.
3. Remove the twist-lock disconnect plug.
4. Open the control accessory panel.
5. Remove the module to be bypassed.
6. Slide the keying plug(s) to the right and pull out from the printed circuit board receptacle. Note position of the keying plug(s) when removing.
7. Close the control accessory panel.
8. Spec A only: Set switches S1 and S2 on the bypass module 300-0927 to the correct position (instructions on bypass module printed circuit board) for the particular bypass and insert the module. See Figure 40.

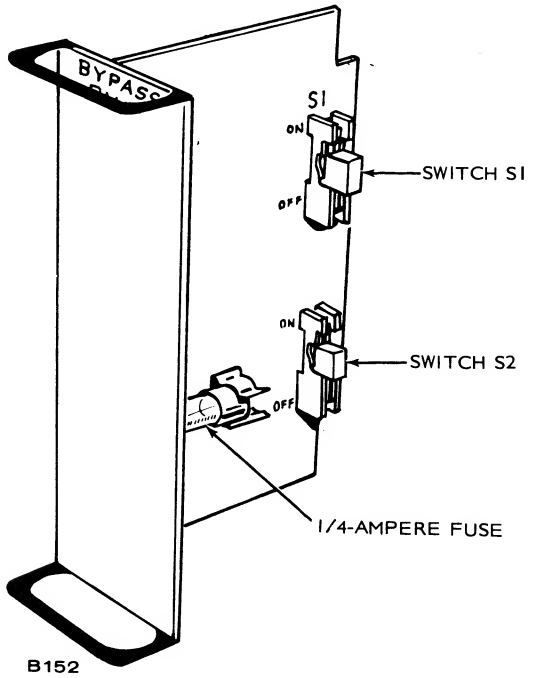

FIGURE 40. BYPASS PLUG MODULE

9. Connect the disconnect plug, reposition the operation selector switch and check operation of the automatic transfer switch.

If the 1/4 ampere fuse on the bypass plug burns out, check and correct switch positions, then replace the fuse before inserting the bypass module again.

10. Move the operation selector switch to STOP after test is finished.
11. Remove disconnect plug and open control accessory panel.
12. Take out bypass plug module and reinstall keying plug(s) removed in Step 6.
13. Reinstall module from Step 5 or install new module, if required.
14. Close control accessory panel and connect the disconnect plug.
15. Move the operation selector switch to REMOTE on engine control for two-wire starting with OT-C or OT-D control, or move operation selector switch in OT-E cabinet to NORMAL for three-wire starting, whichever applies.
16. Close the cabinet door.

Start-Stop Bypass Plug Module

Use this bypass plug module in place of the start-stop time delay module in position 7 of the control accessory panel. Use a 300-1648 bypass plug module for begin Spec B automatic transfer switches, a 300-1177 bypass plug module for Spec A automatic transfer switches.

You do not have to remove the keying plugs from the printed circuit board receptacle when using these bypass plug modules.

1. Open cabinet door of automatic transfer switch.
2. Move the operation selector switch to STOP (on engine control for two-wire starting with OT-C or OT-D control, or in cabinet for three-wire starting with OT-E control). Tag selector switch.
3. Remove start-stop time delay module 7.
4. Insert the bypass plug module into position 7.
5. Reposition the operation selector switch and check operation of the automatic transfer switch.
6. Move the operation selector switch to "STOP" after the test is finished.
7. Remove the start-stop bypass plug module.
8. Reinstall module from Step 3 or install new module, if required.
9. Move the operation selector switch to REMOTE on engine control for two-wire starting with OT-C or OT-D control or move operation selector switch in OT-E cabinet to NORMAL for three-wire starting, whichever applies.
10. Close cabinet door.

OTs WITH CONTROL PANEL GROUPS 51 THROUGH 55

Find the problem below and proceed to the page indicated. Then answer the questions in the chart on that page either "YES" or "NO." Refer to the number in the column and proceed to that step, etc.

INDEX

A	OT fails to immediately connect load to line when generator set is not operating.	YES	NO
1A	Is normal line energized and delivering rated voltage to the line terminals of the transfer switch?	2A	—
2A	Is the control panel disconnect plug properly inserted into receptacle?	3A	—
3A	Is actuator switch S1 on transfer switch assembly in the up (closed) position?	4A	—
4A	Move actuator switch to down (open) position. Can you operate the transfer switch manually? (Move transfer switch back to original position if you were able to operate it.)	6A	5A
5A	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
6A	Does OT have an interposing relay K1?	7A	12A
7A	Does OT have rated AC voltage between TB31-1 and TB31-2?	9A	8A
8A	Replace interposing relay K1.	—	—
9A	Are contacts K3 (5-6), K3 (3-4) for a 480 or 600-volt system, closed and making good contact?	11A	10A
10A	Replace relay K3.	—	—
11A	Does OT have programmed transition time delay K9 (located on transfer switch base).	12A	14A
12A	Close actuator switch S1 (up position). With the control panel disconnect plug connected, jumper time delay K9 terminals 1 and 5, K9 terminals 2 and 6 for a switched neutral transfer switch with two linear actuator motors. Does transfer switch operate? **WARNING** ***High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!***	13A	14A
13A	Repair or replace time delay K9.	—	—
14A	Does OT transfer switch have two linear actuator motors (one for switching neutral)?	17A	15A
15A	Remove AC power from the OT automatic transfer switch and remove the generator set starting battery. Remove the auxiliary switch cover from the left side of the transfer switch (leave wire leads connected). With the transfer switch contacts open on the normal side, is there continuity between COMMON and NORMALLY CLOSED terminals of cutoff switch S2?	19A	16A

A	(Continued)	YES	NO
16A	Replace microswitch and adjust new microswitch as described in *TRANSFER SWITCH* section.	—	—
17A	Remove AC power from the OT automatic transfer switch and remove the generator set starting battery. Remove the auxiliary switch covers (leave wire leads connected to actuator switch S1 and circuit breaker(s) on large auxiliary switch cover). Manually operate transfer switch to open normal-side power and neutral contacts and to close those on emergency side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each normal-side auxiliary switch and continuity between COMMON and NORMALLY OPEN terminals of each emergency-side auxiliary switch. Are switches okay?	18A	16A
18A	Manually operate the transfer switch to open the emergency-side power and neutral contacts and to close those on normal side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each emergency-side auxiliary switch and continuity between COMMON and NORMALLY OPEN terminal of each normal-side auxiliary switch. Are switches okay?	19A	16A
19A	Is there continuity across actuator switch S1 terminals when the switch is in the closed (up) position?	21A	20A
20A	Replace actuator switch S1.	—	—
21A	Is there continuity across actuator circuit breaker terminal (resistance should be near zero if OK)?	23A	22A
22A	Replace circuit breaker.	—	—
23A	Measure the resistance of the linear actuator M1 windings. Table 2 of the *TRANSFER SWITCH* section lists the correct winding resistances. Replace the linear actuator if necessary.	—	—

B	OT fails to connect load to generator set when set runs during test with load or a normal power outage.	YES	NO
1B	Is generator output near rated voltage?	2B	—
2B	Is actuator switch S1 in the up (closed) position? (Some models require removing disconnect plug and opening control panel to see switch S1).	4B	3B
3B	Move actuator switch S1 to up position.	—	—
4B	Move actuator switch S1 to down (open) position. Can you operate the transfer switch manually?	6B	5B
5B	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
6B	Does OT have a transfer time delay K13?	7B	10B
7B	Is time delay completed?	8B	—
8B	Remove disconnect plug and open control accessory panel. Using great care against shock hazard and personal injury, connect the disconnect plug back into the receptacle with the control panel open. Does transfer switch operate if terminal K13-1 is jumpered to K13-5 (jumper K13-1 to K13-2 for 480-volt or 600-volt system)? **WARNING** ***High voltages are present within the control cabinet which might cause serious personal injury or death. Proceed with care!***	9B	10B
9B	Repair or replace transfer time delay K13.	—	—
10B	Is transfer inhibit circuit connected to terminals TB6-11 and -12?	11B	13B
11B	Does transfer switch operate if TB6-11 is jumpered to TB6-12?	12B	13B
12B	Check for malfunction in inhibit circuit.	—	—
13B	Does OT have voltage sensor modification?	14B	16B
14B	Does OT operate if terminal TB-6 is jumpered to TB6-11?	15B	16B
15B	Check setting of voltage sensor(s). If OK, replace module with bypass plug to determine which voltage sensor, if more than one, is faulty.	—	—
16B	Are relay contacts K4 (3-4) closed and making good contact?	18B	17B
17B	Replace relay K4.	—	—

B	(Continued)	YES	NO
18B	Are relay contacts K3 (1-3), or K3 (5-6) for 480- or 600-volt OT, closed and making good contact?	20B	19B
19B	Replace relay K3.	—	—
20B	Does OT have an interposing relay K1?	21B	23B
21B	Is nominal AC voltage present between terminals TB31-2 and TB31-3?	23B	22B
22B	Replace interposing relay K1.	—	—
23B	Does OT have programmed transition time delay K9 (time delay K9 mounted on transfer switch base)?	24B	29B
24B	Does OT transfer load to generator set if you jumper programmed transition time delay K9 terminals 2 and 6, K9 terminals 1 and 5 for switched neutral transfer switch with two linear motors?	25B	26B
25B	Repair or replace time delay K9.	—	—
26B	Does OT transfer switch have two linear actuator motors (one for switching neutral)?	32B	27B
27B	Remove AC power from OT automatic transfer switch and remove generator set starting battery. Remove the auxiliary switch cover from the left side of the transfer switch (leave wire leads connected). With the transfer switch closed to the normal side, is there continuity between the COMMON and NORMALLY CLOSED terminals of cutoff switch S6?	35B	28B
28B	Replace microswitch S6 and adjust new microswitch as described in the *TRANSFER SWITCH* section.	—	—
29B	Does OT transfer switch have two linear motors (one for switching neutral)?	32B	30B
30B	Remove AC power from the OT automatic transfer switch and remove generator set starting battery. Remove the auxiliary switch cover with actuator switch S1 from the side of the transfer switch (leave wire leads connected). With the transfer switch closed to the normal side, is there continuity between the COMMON and NORMALLY CLOSED terminals to cutoff switch S5?	35B	31B
31B	Replace microswitch S5 and adjust new microswitch as described in *TRANSFER SWITCH* section.	—	—

B	(Continued)	YES	NO
32B	Remove AC power from the OT automatic transfer switch and remove generator set starting battery. Remove the auxiliary switch covers (leave wire leads connected to actuator switch S1 and circuit breakers on left auxiliary switch cover). Manually operate transfer switch to open normal-side power and neutral contacts and to close those on emergency side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each normal-side auxiliary switch and continuity between COMMON and NORMALLY OPEN terminals of each emergency-side auxiliary switch. Are switches okay?	33B	34B
33B	Manually operate transfer switch to open the emergency-side power and neutral contacts and to close those on the normal side. There should be continuity between the COMMON and NORMALLY CLOSED terminals of each emergency-side auxiliary contact and continuity between the COMMON and NORMALLY OPEN terminals of each normal-side auxiliary switch. Are switches okay?	35B	34B
34B	Replace defective microswitch and adjust as described in *TRANSFER SWITCH* section.	—	—
35B	Is there continuity across actuator switch S1 terminals when switch is in up (closed) position?	37B	36B
36B	Replace actuator switch S1.	—	—
37B	Is there continuity across actuator circuit breaker terminals (resistance should be near zero if OK)?	39B	38B
38B	Replace circuit breaker.	—	—
39B	Measure the resistance of the linear actuator M1 windings. Table 2 of the *TRANSFER SWITCH* section lists the correct winding resistances. Replace the linear actuator if necessary.	—	—

C	OT fails to start generator set during a power outage.	YES	NO
	OT-C AND OT-D (Two-Wire Start)		
1C	Place automatic transfer switch selector switch S2 to TEST. Does generator set start?	6C	2C
2C	Is selector switch on engine control in REMOTE position?	3C	—
3C	Does generator set start, run and stop with switch located on engine control? Return switch to remote position.	4C	—
4C	Jumper TB1-B+ to TB1-RMT. Check to ensure that voltage from GND to TB1-RMT is equal to battery rated voltage. Does engine crank?	5C	6C
5C	Check circuit from TB1-B+ through OT switch S2 (1-2) to TB-RMT for loose connections or open circuit.	—	—
6C	Does OT have a start time delay K7?	7C	8C
7C	Has time delay K7 completed its delay?	8C	—
8C	Does generator set start if terminal K7-1 is jumpered to K7-5?	9C	—
9C	Replace relay K7.	—	—
	OT-E (Three-Wire Start)		
1C	Place automatic transfer switch selector switch S2 to TEST. Does generator set start?	12C	2C
2C	Has an engine overcrank occurred? Check overcrank button on OT control accessory panel.	3C	4C
3C	See generator set manual.	—	—
4C	Jumper terminal K5-1 to K5-2. Does generator set start and run?	5C	6C
5C	Replace cranking limiter assembly.	—	—
6C	Does OT have a preheat time delay for a diesel generator set?	7C	10C
7C	Has preheat time delay completed its delay?	8C	—
8C	Does generator set start and run if terminal TB1-H is jumpered to TB1-3?	9C	10C
9C	Check preheat time delay circuit for an open and replace time delay if necessary.	—	—
10C	Jumper contacts K4 (1-2). Does engine crank?	11C	—
11C	Replace relay K4.	—	—
12C	Move selector switch back to NORMAL. Does OT have automatic exercise clock?	13C	15C

C	(Continued)	YES	NO
13C	Does generator start and run if exerciser contact M1-4 is jumpered to M1-5?	14C	15C
14C	Replace the microswitch on the exerciser clock or replace exerciser clock.	—	—
15C	Does OT have a start time delay relay K7?	16C	17C
16C	Has time delay K7 completed its delay?	17C	—
17C	Does generator set start if terminal K7-1 is jumpered to K7-5?	18C	—
18C	Replace relay K7.	—	—

D	**OT fails to automatically retransfer load from generator set to line after normal power returns. Generator set continues to run.**	YES	NO
1D	Is control panel disconnect plug inserted completely into receptacle?	2D	—
2D	Is test transfer switch S1 in closed (NORMAL) position?	3D	—
3D	Is rated AC voltage present at transfer switch line terminals?	4D	—
4D	Is actuator switch S1 on transfer switch in up (closed) position? (Some models require opening control panel to see S1).	5D	—
5D	Move actuator switch S1 to down (closed) position. Can you operate the transfer switch manually? (Move transfer switch back to original position if you were able to operate it.)	7D	6D
6D	See the *TRANSFER SWITCH* section for maintenance and repair information.	—	—
7D	Does automatic transfer switch have area protection equipment or remote test switch connected to terminals TB1-4 and TB1-5?	8D	10D
8D	Jumper terminals TB1-4 to TB1-5. Does automatic transfer switch retransfer load to line at end of retransfer time delay, if used?	9D	10D
9D	Check area protection equipment or remote test switch for malfunction (circuit must be closed for retransfer).	—	—
10D	Is automatic transfer switch a 3-phase OT?	11D	13D
11D	Is rated AC voltage (nominal 220 with 480- or 600-volt system) present between terminals K10-6 and K10-8?	13D	12D
12D	Replace phase protection relay K6.	—	—
13D	Does OT have a retransfer time delay relay K10?	14D	6A
14D	Has motor timer completed time delay period? Time delay expired if AC voltage is present between terminals K10-6 and K10-7.	6A	15D
15D	Replace motor timer if it is stalled (does not time out).	—	—

E	OT delays transferring load to line until generator set stops after a power outage.	YES	NO
1E	Does OT have a retransfer time delay K10?	2E	5E
2E	Has time delay completed delay period? Time delay expired if AC voltage present between terminals K10-6 and K10-7 (with generator set running—K4 energized).	3E	—
3E	Does transfer switch retransfer load to line if terminal K10-8 is jumpered to K10-7?	4E	5E
4E	Repair or replace retransfer time delay K10.	—	—
5E	Do relay contacts K3 (5-6), contacts K3 (3-4) for 480- or 600-V system, close when the normal source voltage returns?	6E	7E
6E	Clean K3 contacts. Does this correct problem?	—	7E
7E	Replace relay K3.	—	—

F	Generator set starts during normal power service.	YES	NO
1F	Is operation selector switch S1 positioned at NORMAL?	2F	—
2F	Is control panel disconnect plug inserted completely into receptacle?	3F	—
3F	Does automatic transfer switch have an exerciser clock?	4F	5F
4F	Is exerciser clock turned to exercise period?	—	5F
5F	Is rated AC voltage present at transfer switch terminals?	6F	—
6F	Does OT have voltage sensor modification?	7F	9F
7F	Record pick-up voltage dial settings with small pencil marks on the modules. Turn the pick-up voltage knobs to 90 or below. Does generator set stop (after time delay if applicable)? After test, return knobs to original settings.	8F	9F
8F	Recheck the normal line voltage and output voltage of transformer or voltage sensor modification for lower than normal readings. Make sure voltage sensors are set for correct pick-up voltage.	—	—
9F	Is automatic transfer switch a 3-phase OT?	10F	12F
10F	Is phase protection relay K6 energized and the contacts K6 (3-5) closed and making good contact?	12F	11F
11F	Replace phase protection relay K6.	—	—
12F	Does OT have a start time delay K7?	13F	14F
13F	Measure for rated AC voltage (nominal 220 with 480- or 600-volt system) from terminal K7-L1 to K7-L2. If present, repair or replace start time delay relay K7.	—	—
14F	Is start-stop relay K7 energized and are contacts K7 (1-5) open?	—	15F
15F	Replace start-stop relay K7.	—	—

G	Exercise clock does not start generator set.	YES	NO
1G	Does exerciser motor timer M1 operate?	2G	15G
2G	Is operation selector switch S2 at NORMAL?	3G	—
3G	Has overcrank condition occurred?	—	4G
4G	Does generator set have two-wire starting with OT-C or OT-D?	5G	6G
5G	Are contacts M1 (3-5) closed and making good contact to put battery voltage on TB1-RMT terminal during exercise period? See instructions for exercise clock adjustments.	—	16G
6G	Are contacts M1 (4-5) open and M1 (3-5) closed during exercise period? See instructions for exercise clock adjustments.	7G	16G
7G	Jumper terminal K5-1 to K5-2. Does generator set start and run?	8G	9G
8G	Replace cranking limiter assembly.	—	—
9G	Does OT have a preheat time delay for a diesel generator set?	10G	13G
10G	Has preheat time delay completed its delay?	11G	—
11G	Does generator set start and run if terminal TB1-H is jumpered to TB1-3?	12G	13G
12G	Check preheat time delay circuit for an open and replace time delay if necessary.	—	—
13G	Jumper contacts K4 (1-2). Does engine crank?	14G	—
14G	Replace relay K4.	—	—
15G	Replace the exerciser clock.	—	—
16G	Replace the microswitch on the exerciser clock or replace exerciser clock.	—	—

H	Overcrank lamp does not light on overcrank condition (OT-E Only)	YES	NO
1H	Has overcrank reset button popped out on control accessory panel?	2H	—
2H	Is battery voltage present between terminals TB6-1 and TB6-9?	3H	4H
3H	Check wire connections at OVERCRANK lamp. Replace lamp if burned out.	—	—
4H	Check cranking limiter K5 and replace if necessary.	—	—

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